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ABSTRACT

The Cluster Concept Program (CCP) for 11th and 12th grade vocational education, has completed its second year. The program is designed to prepare youth for entry level capability in a variety of related occupations rather than a specific occupation. A pretest/posttest research design, with control and experimental group design in construction cluster groups, metal fabrication cluster groups, and electromechanical cluster groups was used to obtain an estimate of the effectiveness of the programs. It was found that in some schools the programs did significantly change the student behaviors in the direction of the state objectives of the programs. Changes in cognitive abilities, broadened knowledge and job interests, flexibility of occupational choice and growth in the performance of skill tasks were observed. The appendixes contain measurement instruments and achievement tests used in program evaluation. Related course outlines and final reports are available as ED 010 301-ED 010 304, ED 016 841-ED 016 844 and ED 022 965. (GR)

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THE IMPLEMENTATION AND FURTHER DEVELOPMENT OF EXPERIMENTAL CLUSTER CONCEPT PROGRAMS THROUGH TESTING AND EVALUATION INCLUDING PLACEMENT AND FOLLOW-UP OF SUBJECTS

THE CLUSTER CONCEPT PROJECT
Phase IV

Dr. Donald Maley
Principal Investigator
Professor and Head
Industrial Education Department

Dr. Walter S. Mietus
Research Coordinator
University of Maryland
College Park, Maryland

August 1969

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The Cluster Concept research staff of the University of Maryland is indebted to the teachers who energetically implemented the programs under study. Many problems which interjected burdens upon the daily process of pedagogy were encountered. Teacher resourcefulness and additional time for study and preparation far beyond the usual expectations were demanded for the implementation of the new programs.

The research staff wishes to express its gratitude to Mr. James L. Reid, Director of the Division of Vocational Education and to Mr. Warren Smeltzer, Assistant Director of Vocational Education of the Maryland State Department of Education.

Grateful appreciation is directed to all of the county supervisors and high school principals who contributed in a variety of significant ways to the completion of two years of field research. The decision was made that within this evaluative study the names of these educational leaders and teachers would remain anonymous.

The principal investigator is pleased to acknowledge the work done by Walter Mietus, the director of the research and for the preparation of this document, and to the research associates: Joseph Abromaitis, Gregory Berbert, Luther Burse, John Gallinelli, and Kenvyn Richards, and to a diligent secretary, Rose Marie Dorn.

Donald Maley
Department Head and Principal Investigator
August, 1969

SUMMARY OF PROJECT

Introduction

The cluster concept programs were developed as alternate forms of vocational education in response to constructive suggestions gleaned from research of other disciplines. The programs were aimed at the preparation of eleventh and twelfth grade youth for entry level capability into a variety of related rather than specific occupations. They were based on the premise that educational experiences encompassing a range of related occupations appear defensible for most secondary students who have no realistic basis for decision making when selecting to study a specific trade. The programs were designed to enhance the individual's employability by providing a wide range of transferable entrance skills. Common job elements incorporated in the programs promoted articulation vertically and horizontally across several occupations.

The power of the programs was derived from the identification of job tasks which were further analyzed into human requirements. It was within the underlying aspects of human requirements where commonalities were identified. For a full explanation of this procedure, and more concise information, reference should be made to the previous documents which emerged as products of four years of research.

The first year (or phase) of the research established the acceptability and feasibility of the programs and generated curricula for the occupational clusters of: (1) Construction, (2) Metal

Forming and Fabrication, and (3) Electro-Mechanical Installation and Repair. The completion of phase II resulted in the production of curriculum guides, course outlines, instructional materials, and the selection and training of teachers to implement the programs. Phase III was an evaluation of the first year of field experimentation and implementation. Eleven high schools in four Maryland counties participated by incorporating pilot programs. The primary purpose was to determine in a field setting the adequacy and effectiveness of the curriculum guides, course outlines, course contents, and the preparation of the newly trained teachers. Newly developed achievement tests, rating scales, inventories, check lists and standardized tests were used to obtain descriptive, comparative and quantitative data. Continuous feedback information and inferences from the data gathered enabled the identification of areas for improvement, making additions and changes and determining remedial measures for the program.

Phase IV, reported herein, is an evaluation of the second year of experimentation with the pilot programs. Since it marked the completion of the two-year program and graduation for the subjects, placement activities were carried out and the first post high school jobs of students were analyzed.

Research procedures of phase IV were replications of those in phase III. It incorporated the pretest/posttest with control and experimental group design. The problems investigated were those which provided an indirect estimate of the effectiveness of the pilot programs.

Problems. The four principal areas of investigation included the determination of:

1. The impact of the cluster program on selected cognitive, affective and psychomotor (task performances) behaviors of the subjects of the experiment.
2. The sufficiency and the appropriateness of the content and methods of the cluster program and instructional materials.
3. The educational process, its adequacy and appropriateness with a consideration of: administrative support, teacher effectiveness, and environmental conditions.
4. The employability of the graduates of the cluster program in the occupations for which they sought to gain entry level skills.

Treatment of the data. Each pilot program was evaluated separately. Comparability or homogeneity of the students forming experimental and control groups was established on the basis of intelligence test scores (lingual or verbal) and in one school, on the basis of a Mechanical Reasoning Test.

To determine if there were significant differences between initial scores and final scores, and if there were any differences between the groups, the analysis of variance statistic and in some cases non-parametric statistics were used. The .01 level of significance was considered minimal in all data analyzed.

Findings. Statistical analysis of the data derived by investigating the first area specified above indicated the following:

(a) Subjects of the construction cluster had intelligence quotients which ranged from 87 to 99. On the basis of the achievement test data, one program out of four attained the objectives to a significant degree. The three other field operations only achieved moderate success.

(b) The results from statistical treatment of the data indicated that all four programs of the metal forming and fabrication cluster were achieving the prescribed objectives as measured with the use of achievement tests.

(c) Data derived from schools conducting the electro-mechanical installation and repair cluster supported the findings that only modest changes of behaviors in the students were observed and that these were statistically insignificant.

In summary, it was observed that some programs were highly successful whereas others fell short of achieving the established cognitive objectives.

Affective behaviors. The affective behaviors studied were limited to occupational preferences and interests measured with the Minnesota Interest Inventory and a supplementary questionnaire constructed by the research team.

The supplementary instrument was designed to obtain an estimate of the student's knowledge and attitude relevant to selected job factors such as human relations, job status, security, advancement, intrinsic and extrinsic feelings about jobs.

Findings. A significant number of students showed an awareness of the meaning of the first job and the concept of career development as a life-long process. More diversity or flexibility of expressed job choice was observed to take place within the cluster group rather then the control group. A greater degree of fluctuation in the direction of or away from occupations the students actively studied was observed, whereas less fluctuation of attraction for unfamiliar occupations was exhibited.

Task performances (psychomotor behaviors). Field observations were conducted during which evaluations and records of specific overt behaviors of the students and teachers were made. The specific behaviors were referred to as job tasks, all of which have been written in behavioral terms and then identified by observation.

Findings. During the two-year pilot programs no field operation completed all the tasks structured into the programs. Programs implementing the metal forming cluster completed from 67 to 98 percent of the tasks. The construction cluster programs completed from 52 to 79 percent of the prescribed tasks. The electro-mechanical cluster groups completed from 29 to 60 percent of the tasks.

The optimum potential of the programs was not achieved. There was sufficient evidence to indicate that while the teachers understood the requirements of the new programs, they lacked the ability to fully integrate job task commonalities. Only continued and repeated experience would resolve this inadequacy.

The problems and difficulties encountered in the process of implementing the tasks formed a basis to improve the programs. Supplementary pedagogical activities were further suggested to extend the course activities and instructional plans. Two kinds of activities were listed. One was intended mainly for individual competency building exercises within one occupation while the other was intended for group participation and experiences with coordinated tasks from several occupations.

The educational process. The third area of investigation was concerned with the evaluation of selected supportive dimensions including the administration, teacher, physical facilities, and community acceptance. The following devices were used to obtain descriptive data: (1) interviews, (2) records and activities of teachers, (3) inventory forms for tools, equipment, and materials, (4) drawings and sketches of physical facilities, (5) visual media, drawings, plans, photographs, and written descriptions of practical work performed while implementing the courses of study, and (6) progress charts and evaluation tables.

Findings. The use of school shops which were primarily designed for the study of a single occupation presented restrictions on the activities of the cluster programs. Some schools remodeled their facilities, thus providing the additional space and power requirements. There was a severe lag time between requisition and acquisition of tools, equipment, and materials. These problems caused the teachers to artificially emphasize certain units of study while they awaited the fulfillment of requisitions. The sequence and balance of the structured programs was disturbed. Where administrative support was strong, these problems were gradually resolved, whereas in a few schools these problems continued for the two-year period.

Placement of efforts. The final dimension of the project was concerned with assisting the subjects of the cluster programs in making the transition from school to the world of work. Extra efforts such as developing school and community awareness, the systematic preparation and presentation of student cluster experiences, interests and abilities, and the systematic analysis of employer activities, provided an optimum service to the students. Four weeks after graduation 86 percent of the subjects were gainfully employed and up to 60 percent of the subjects were working in cluster-related jobs. No longitudinal study was made since this research terminated on the date of this document. Feedback data would be highly beneficial for the further improvement of these programs. A proposal for further study has been submitted.

Conclusions

The action research completed with the pilot programs made it evident that the cluster concept programs have the potential of becoming vigorous, alternate forms of vocational education. It was found that in some schools the programs did significantly change the student behaviors in the direction of the stated objectives of the programs. Changes in cognitive abilities, broadened knowledge and job interests, flexibility of occupational choice and growth in the performance of skill tasks were observed. The full power of the programs was not achieved in the pilot programs. There was considerable evidence to believe that continued work and experience would bring out the optimum power of cluster programs.

PART I

INTRODUCTION

This report includes an evaluation of the second and final year of field research with the Cluster Concept Programs of vocational education. This report is limited in that it does not present detailed information relevant to the previous three years of research and development which formed the foundations and which were presented in other documents. Researchers, practitioners, and others who seek a thorough understanding of this fourth report and the cluster concept programs are urged to make reference to previous documents which emerged as products and have become public domain. The source from which materials may be obtained is:

ERIC Document Reproduction Service
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Bethesda, Maryland 20014

Reference to the designated ERIC numbers given below will expedite the procurement of the documents.

Course Outlines 1966		Instructional Plans 1967	
Final Report	ED010301	Final Report	ED016841
Construction	ED010302	Construction	ED016842
Electro-Mech.	ED010303	Metals	ED016843
Metals	ED010304	Electro-Mech.	Edo16844

1968 Final Report Ed 022965

Summary of Previous Research

A brief summary of the rationale, objectives, activities, methodology, and accomplishments is presented to provide the reader with a proper orientation to the nature, scope, and background of the cluster approach to vocational education. It is hoped that this will help the reader in achieving closure at the completion of reading these materials. Also provided are certain critical aspects of the program which form the evaluative criteria such as task analyses and human requirements.

Phase I, or the first year efforts, began in September of 1965. During that time the cluster concept was investigated as a form of vocational education at the eleventh and twelfth grade of secondary education. The cluster concept, as envisioned, was aimed at the preparation of individuals for entry level capability in a variety of related rather than specific isolated occupations. It was based on the premise that educational experiences with a range of related occupations appear defensible for most students who have no realistic basis for decision making along the lines of selecting a specific trade. The cluster concept program was designed to enhance the individual's potential employability by virtue of offering a wider range of entrance skills and a level of articulation across several occupational areas. This type of fundamental training, it is believed, will enable the individual to move back and forth over several occupational categories as well as vertically within the occupation.

Rationale and Justification for the Cluster Concept

The rationale of the cluster concept program was built on findings and recommendations from research in the fields of guidance, vocational placement, education, military training, and psychology. A sample of these is presented in the following discussion.

The cluster concept program was designed to provide secondary vocational students with a greater degree of flexibility for vocational decision making rather than demanding, at an early age, a commitment to "one-goal directed" traditional programs. The student will have experience in a family of related occupations; the decision to select one single trade is not demanded. With a similar point of view, Baer and Roeber, in writing on the dynamics of vocational choice, concluded:

> Since most young people have a broad range of interests and capabilities, appropriate initial choices are facilitated by a knowledge of families of occupations. It is becoming more generally recognized that early training, even at the college level, should be broad enough to give the student the background for a group of related occupations. Thus he is not driven into a specific occupational choice before his interests have matured sufficiently for him to choose a field of work. When he is ready to enter the job market, his chances of successful placement are increased if he is prepared to begin at any one of several jobs in a given field of work. If this field happens to be commercial art, for example, he could become a poster artist, sign writer, catalog illustrator or layout man. Once hired, he has a better chance of promotion if he has been trained for a group of related occupations. Should he lose his job as a result of adverse business conditions or obsolescence of the occupation, he can switch to another job in the same occupational family.[1]

The final report of the panel of consultants on vocational education appointed by the Secretary of Health, Education, and Welfare contained the following recommendation:

> Basic vocational education programs should be designed to provide education in skills and concepts common to clusters of closely related occupations. The curriculum should be

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[1] Max Baer and Edward C. Roeber, Occupational Information (Chicago: Science Research Associates, 1964), p. 167.

> derived from analyses of the common features of the occupations included. These students should receive specialized or more advanced vocational training later in post high school programs, apprenticeships, or on-the-job experiences.[2]

Support for the soundness of the postponement of the decision to follow one trade due to distinct periods of vacillation in choice is provided by Eli Ginzberg who indicated:

> . . . The period during which the individual makes what can be described as a fantasy choice; the period during which he is making a tentative choice; and the period when he makes a realistic choice. The first coincides in general with the latency period, between six and eleven, although residual elements of fantasy choices frequently carry over into the preadolescent years. The second coincides by and large with early and late adolescence; with a few exceptions, realistic choice is made in early adulthood. To some degree the way in which a young person deals with his occupational choice is indicative of his general maturity, and conversely, in assessing the latter, consideration must be given to the way in which he is handling his occupational choice problem.[3]

In a state-wide inquiry held in Wisconsin and sponsored by the U.S. Office of Education, J. K. Little obtained information relative to 4,186 non-college youth. Only 8.7 percent indicated plans for obtaining specific vocational education, but the action of the same body of students indicated that 15.9 percent went into vocational programs. While the forces prompting youth to acquire education beyond the high school are clearly visible, formal education ended at the end of high school for 60 percent of the group. For 73 percent, education stopped short of completing a baccalaureate degree.[4]

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[2] U.S. Department of Health, Education and Welfare, Office of Education, Education for a Changing World of Work (Washington: Government Printing Office, 1964), p. 227.

[3] Eli Ginzberg, Occupational Choice (New York: Columbia University Press, 1951), p. 60.

[4] Kenneth J. Little, "The Occupations of Non-College Youth," American Educational Research Journal, Vol. 4, No. 2, March (1967), p. 153.

> An important item of unfinished educational business then is conceiving and developing realistic and practical programs of 'middle education' (occupations that include clerical workers, salesworkers, craftsmen, foremen and sub-professional technicians)--the level between mid-high school and mid-college--during which three fourths of American youth end their formal schooling. These are the youth who as adult workers occupy the great range of middle level occupations and who as citizens are the bedrock of a democratic society.[5]

The 15.9 percent that enrolled into vocational programs represents a potential supply of sub-professional workers considerably lower than the demand. It would be reasonable to assume that if exploratory vocational experiences, such as the cluster concept, were provided high school youth, a greater number would elect to work in sub-professional occupations. Evidence to test this hypothesis could be obtained with follow-up research on career development studies on the subjects used in this research.

A nation-wide study of vocational course graduates based upon a representative sample of high schools was conducted under the sponsorship of the Ford Foundation and directed by Max Eninger.[6] It describes the salient post-high school level trade and industry vocational courses. Data collected indicated that 43 percent of the students selected to study vocational courses on the basis of what the students perceived as a job opportunity. This was based on incomplete information which had been directed to him concerning opportunities. This information did not necessarily correspond to actual job opportunity after graduation. The second most frequently acknowledged influence was the parents; friends of the same age were third. The relatively small influence of school personnel is striking. Only 15.1 percent reported a school teacher and 12.3 percent reported that the counselors or guidance personnel had any influence on decisions to study vocational courses.

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[5] Ibid.

[6] Max U. Eninger, The Process and Product of T&I High School Level Vocational Education in the United States (Pittsburgh, Pennsylvania, American Institute for Research, 1965), pp. 5-16.

The percentage of vocational graduates who entered the trade for which they prepared was 29.8 percent, a percentage which decreases during years of low employment in the United States.

With due consideration of findings from other related studies and a special survey study conducted for this research, definite needs were established which served as guidelines for developing the cluster concept programs. A sample of these is synthesized below, but is presented in complete detail in other earlier documents mentioned previously.

1. There is a need to provide students with occupational skills that will enable a greater degree of mobility on a geographical basis.

The Bureau of Census reported:

> Of the 185.3 million persons one year old and over living in the United States in March, 1964, 36.3 million, or 19.6 percent had been living at a different address in the United States in March, 1963 . . . The peak mobility rate occurred among persons in their early twenties--the age at which most young people leave their parental home to find employment . . .[7]

An implication for vocational education with reference to geographical mobility of the population was proposed by Kimball Wiles:

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[7] U.S. Department of Commerce, Bureau of the Census, "Mobility of the Population of the United States, March 1964 to March 1964," Current Population Reports: Population Characterisitcs, September 7, 1965, Census Publication Series P-20, No. 141 (Washington, D.C.: Government Printing Office, 1965), p. 1.

> Vocational education can no longer be planned solely in terms of the community in which a high school exists. Over half of the average school's graduates will migrate to another community, and will go to another state. Seemingly, the wisest step for curriculum planners to take, then, is to study industrial and commerical operations and plan in terms of clusters of competencies. When a student has developed a particular set of abilities he may enter a variety of related occupations.[8]

The importance of mobility, on a geographical basis, was further emphasized by Grant Venn:

> Work mobility is important to occupational well being and competence in an economy increasingly subject to technological dislocation. A company moves to a new state; the award of a government contract causes thousands of jobs to be shifted from one state to another; a new invention wipes out an industry by making it obsolete; whole occupations and job titles are created and abolished--these and other phenomena mark the extent to which occupational education must prepare people to face change. The labor force needs to maintain a high degree of mobility, ability to move from one place to another, and from one job to another. Current rates of occupational and geographical mobility are high, but they are relatively low for the future needs of technology and are misleading as an indication of purpose and direction.[9]

2. There is a need to provide students with transferable skills to enhance mobility for varied jobs within an industry or occupation.

The Bureau of Labor Statistics has found that "during 1961, some 8 million workers--10 percent of the number who worked--shifted from one employer to another . . ."[10] The rate of job changing in 1961 was highest among men and women between the ages of 18 and 24 who were largely unskilled and had little education.[11]

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[8] Kimball Wiles, The Changing Curriculum of the American High School (Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1963), p. 126.

[9] Grant Venn, Man, Education, and Work (Washington, D.C.: American Council on Education, 1965), p. 130.

[10] Gertrude Bancroft and Stuart Garfinkle, "Job Mobility in 1961," Special Labor Force Report, No. 35 (Washington, D.C.: U.S. Department of Labor, Bureau of Labor Statistics, 1963), p. 2.

An implication for the nature of vocational education was proposed by James E. Russell in the publication Automation and the Challenge to Education:

> . . . therefore, to the extent that the school tries to develop employable skills, it should aim at transferable skills, and it should not attempt to train persons for specific jobs that are only temporarily open.[12]

In terms of the requirements of industry, Rumpf has stated that:

> Industry needs workers who are flexible, workers who have a field of skills and basic education that will enable them to adapt rapidly to occupational changes. Workers who are adaptable make installation of new methods and equipment more economical for employers. Management needs workers ready to move into its jobs without long periods of preparation.[13]

3. There is a need to develop occupational abilities which will enable students to adapt to technological changes.

The Department of Labor estimated that about 200,000 non-agricultural workers per year will be displaced because of technological change during the next decade.[14] In five cases studies on the effects of plant layoffs and shut-downs, it was found that in each case technological change was a factor in worker unemployment.[15]

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[11] Ibid.

[12] James E. Russell, "Educational Implications of Automation as Seen by an Educational Policy Planner," Automation and the Challenge to Education, Proceedings of a symposium sponsored by the Project on the Educational Implications of Automation (Washington, D.C.: National Education Association, 1962), p. 42.

[13] Edwin L. Rumpf, "Training the Manpower Catalyst," Manpower and Training Needs of the Food Industry, Report of a National Conference, April 22-24 (Washington, D.C.: Government Printing Office, 1964), p. 10.

[14] Bancroft and Garfinkle, loc. cit.

The future need to develop students of this caliber was further stressed in the Manpower Report of the President:

> Growth and change have characterized the American economy throughout our history, and continual adjustments to shifting manpower requirements by workers, employers, and training institutions have been the rule rather than the exception. Thus, the significant changes in patterns of demand for blue- and white-collar workers, for the skilled and less skilled, and for men and women workers since World War II were no new phenomena. The persistence of the under-lying factors--rising levels of living, associated shifts in consumer purchases, changes in government demand, technological innovations, and productivity growth--implies continued patterns of change in manpower demand.[16]

Peter Drucker, in an address given at the State University College, Oswego, New York, further supported this need:

> A reason why technological education needs to be a part of a general education is that it is no longer of much use to teach any one craft as such. Crafts change too fast. When I was a child forty years or so ago it was quite obvious that anybody who had ever learned a craft had learned enough for the rest of his life. This applied not only to the carpenter or the house painter but to the lawyer and doctor just as well. But today the one thing that is predictable about any craft is that in its present form it is not going to stay around very long. The good Lord did not ordain the crafts. They are man-made and therefore can be altered by man. Crafts that seemed to be as solid as the glacier granite of Upstate New York are dissolving all around us. We will see, for instance, predictably in the next twenty years or so, a complete change of the graphic arts crafts in which not one will remain the way it is. One can also say that this will not mean fewer skilled people, but it will mean people with different skills.[17]

Thomas Brooks supports this need on the basis that the chief traits in demand today are adaptability and versatility:

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[15] Ewan Clague and Leo Greenbert, "Technological Change and Employment," Monthly Labor Review, 85:741-746, 1962.

[16] U.S. Department of Labor, Manpower Report of the President (Washington, D.C.: Government Printing Office, 1965), p. 45.

[17] Peter Drucker, "Knowledge and Technology" (an address delivered at the State University College, Oswego, New York, May 6, 1964).

> It is not uncommon, says a foundry manager, for a man to work on twenty different jobs a year. We take advantage of change in work flow, absences and other factors to move our people around.[18]

An implication for vocational education relative to the impact of technological change was found in the Rockefeller Report on Education:

> In this day of technologies that become antiquated overnight, it is hazardous to predict a favorable future for any narrow occupational category. There will be economic advantage to the individual in acquiring the kind of fundamental training that will enable him to move back and forth over several occupational categories.[19]

Supportive evidence to build a rationale was found in abundance; one hundred and sixty studies were reviewed. To further determine the acceptability and feasibility of developing cluster concept programs, field research was conducted. Representatives from education, government, labor and management were consulted. Interviews, seminars, and questionnaires were used and the resulting reactions were studied. The data gathered from these preliminary investigations strongly tended to indicate that students with a cluster concept background would be desirable potential employees and would be less difficult to adapt because of their broad, general, fundamental training. The data gathered from responsible school administrators also indicated that the implementation of the program into the public schools would not present any major difficulties and that graduates from these programs would be employable.

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[18] Thomas R. Brooks, "The Blue Collar Elite," Dun's Review and Modern Industry, Special Supplement, Part II, March 1964, p. 122.

[19] Rockefeller Brothers Fund, Inc., The Pursuit of Excellence (Garden City, New York: Doubleday and Company, 1958), p. 10.

Developing the Cluster Concept Programs

After making an analysis of the various available occupational classification systems, the decision was made to develop criteria for establishing occupational clusters and for identifying specific occupations within the clusters. Existing strategies and systems were not designed for developing cluster concept programs in vocational education. Emerging from these efforts the following criteria were developed and used.

The occupational cluster should:

1. Be in the area of vocational-industrial education.
2. Include occupations that are related on the basis of similar processes, materials, products, and human requirements.
3. Be broad enough to include occupations with a wide variety of entry level, transferable skills and knowledges.
4. Involve occupations that require not more than a high school education and/or two years beyond high school.
5. Provide for the opportunity for mobility on a geographical and occupational basis.

The three clusters established through the application of the criteria and limitations set for this research are presented in Figure 1. Each of the clusters was analyzed to establish special occupations for each category. The following criteria were used for selection.

The occupation selected must have:

1. A favorable employment outlook.

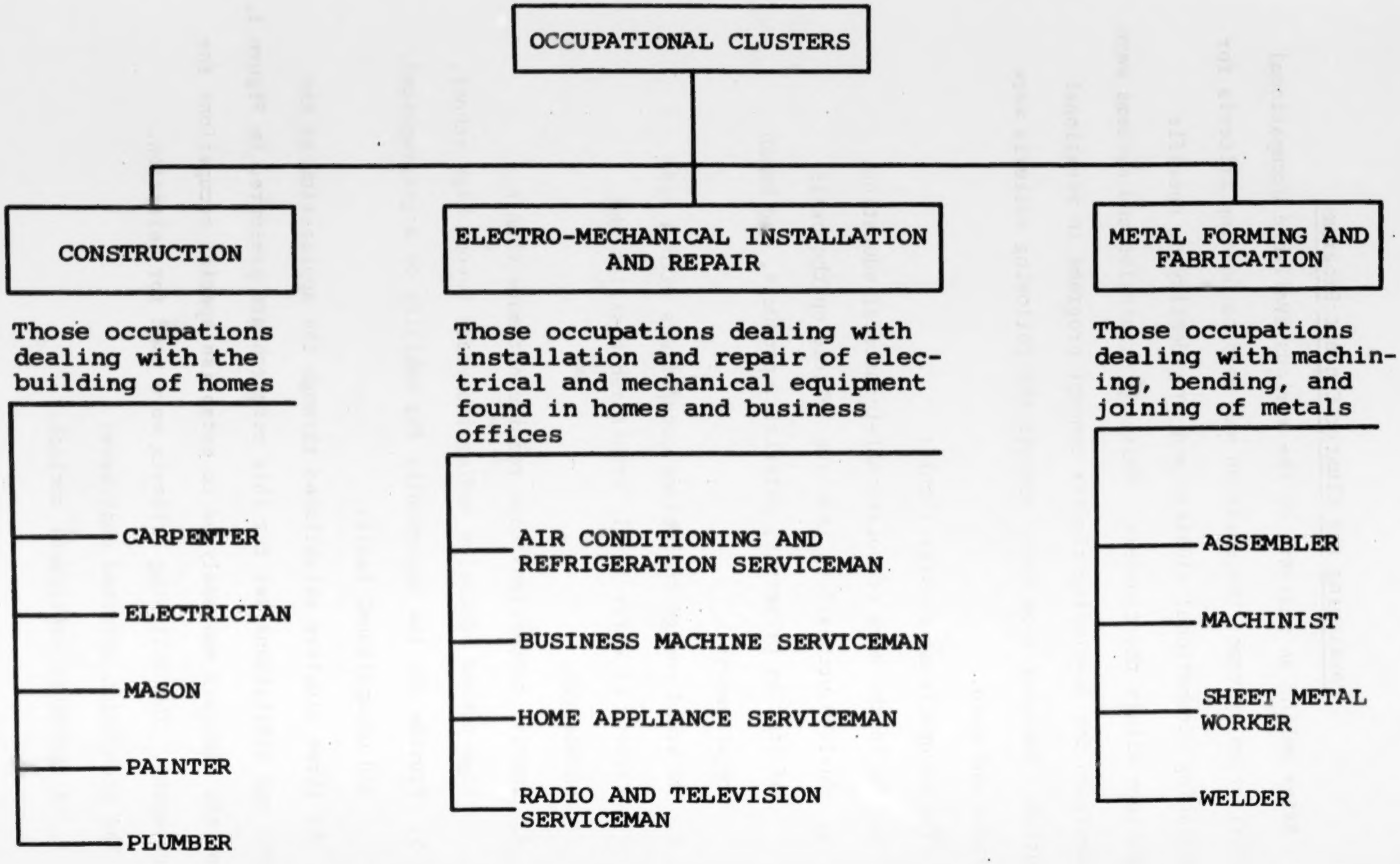
OCCUPATIONAL CLUSTERS
CONSTRUCTION
ELECTRO-MECHANICAL INSTALLATION AND REPAIR
METAL FORMING AND FABRICATION
Those occupations dealing with the building of homes
Those occupations dealing with installation and repair of electrical and mechanical equipment found in homes and business offices
Those occupations dealing with machining, bending, and joining of metals
CARPENTER
ELECTRICIAN
MASON
PAINTER
PLUMBER
AIR CONDITIONING AND REFRIGERATION SERVICEMAN
BUSINESS MACHINE SERVICEMAN
HOME APPLIANCE SERVICEMAN
RADIO AND TELEVISION SERVICEMAN
ASSEMBLER
MACHINIST
SHEET METAL WORKER
WELDER

Figure 1. Occupational Clusters

2. The instructional capability of being implemented in a secondary school program over two academic years.
3. Opportunity for job entry upon graduation from high school.
4. Numerous skills and knowledge providing an opportunity for the identification of commonalities with other occupations.
5. Opportunities for advancement through further schooling, on-the-job training, or apprentice programs.

Task inventories. Central to developing the cluster programs, and concurrently evaluating them, a task inventory of each occupation within a cluster was completed. The task statements were written in a clear, precise and non-ambiguous manner, and expressed in behavioral terms. The format of the task statements is shown in Figure 2. Each task statement began with a behavioral verb (a) which described the action involved in performing a task. The statement also included a noun (b) which described the object acted upon. Modifiers, such as adverbs and adjectives, were used in identifying the object acted upon. The results of the action (c) were stated which described the results of (a) and (b). Modifiers were used to clarify the results of the action and to specify the accuracy or limits that were required in the performance of the task. Whenever possible, the task statement specified the accuracy that was required in the performance of the task. By stating the tasks in this manner, objectivity was achieved; that is, the same criteria for measurement from one individual to another was transmitted and secondly, by observation, task performance could be recorded.

A task describes the work performed by an individual in an

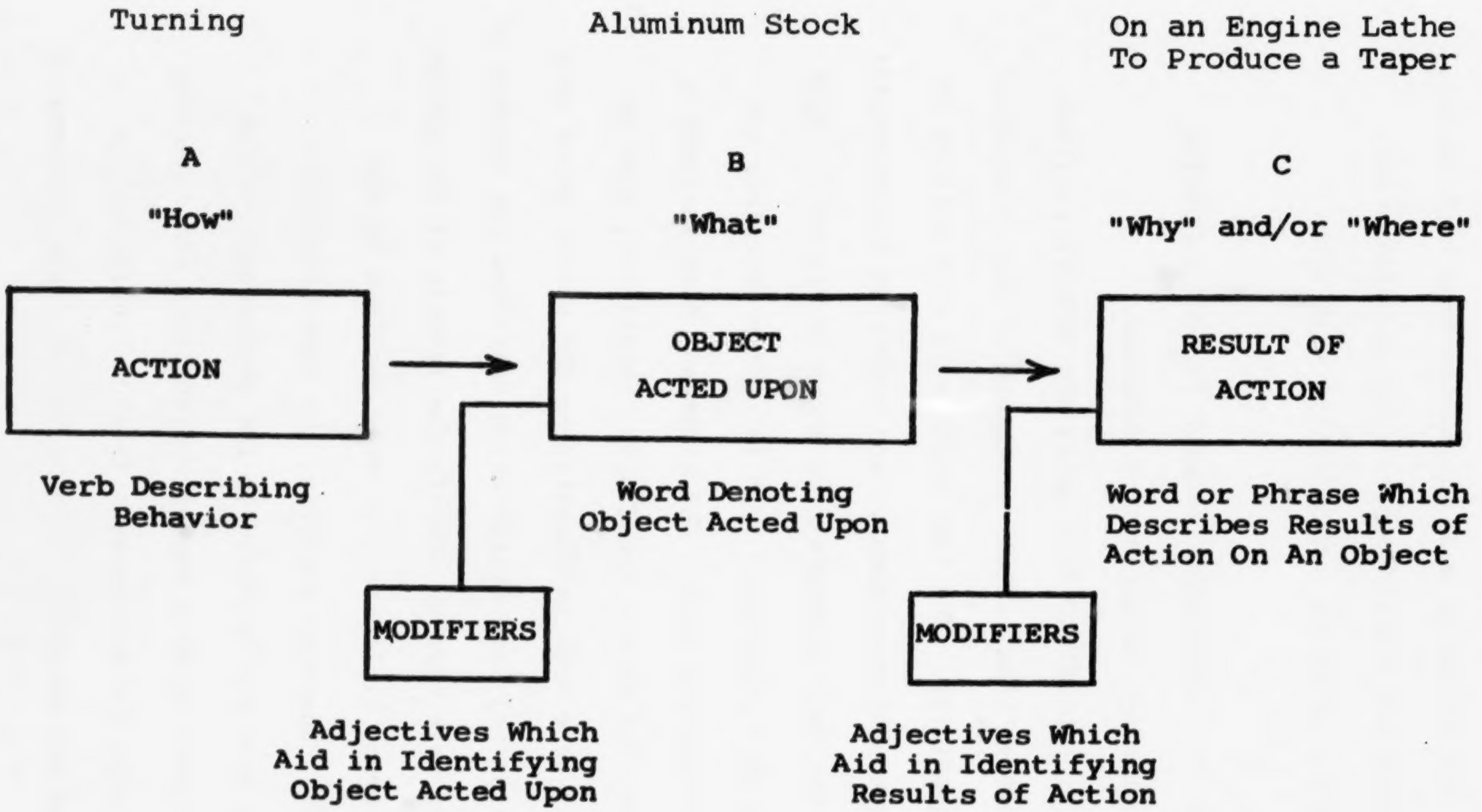
Turning
Aluminum Stock
On an Engine Lathe To Produce a Taper
A
B
C
"How"
"What"
"Why" and/or "Where"
ACTION
OBJECT ACTED UPON
RESULT OF ACTION
Verb Describing Behavior
Word Denoting Object Acted Upon
Word or Phrase Which Describes Results of Action On An Object
MODIFIERS
MODIFIERS
Adjectives Which Aid in Identifying Object Acted Upon
Adjectives Which Aid in Identifying Results of Action

FIGURE 2. TASK STATEMENT FORMAT

occupation and consists of observable human behavior involving more than one area of human requirement. Human requirements, cognitive and psychomotor, that may be involved in the performance of work by an individual in an occupation include:

1. Communications
    - vocabularly
    - symbols
    - drawings and blueprints
    - systems of communication
    - speech
    - English
    - maps
2. Measurement
    - time
    - temperature
    - weight
    - volume
    - length, width, and depth
    - meters (electrical and mechanical)
    - instruments
    - systems of measurement
3. Skills
    - hand
    - mental
    - machine
4. Mathematics and Science
    - practical and applied
5. Information
    - technical
    - operational
    - occupational
    - economic
    - social
    - safety
    - personal hygiene
    - personal standards
    - occupational and job standards

With the cooperation of representatives from management, technical personnel and encumbent journeymen, the tasks were classified into three categories:

1. Level 0

   The task is not needed for the occupation and would not be included for further analysis.

2. Level 1

   The task is needed for entry into the occupation and was included for further analysis.

3. Level 2

   The task was not needed for entry into the occupation but will be needed soon after entry and was included for further analysis.

By this procedure, job entry tasks were identified as well as those tasks necessary on the job three months after being on the job. The completed task analyses, the identified areas of human requirement, and task levels provided the basis for the course outlines, building objective achievement test items, student progress charts, evaluation of teacher progress, and evaluative criteria for use during visitations.

The activities of phase I as well as others are presented graphically in order of sequence in Figures 3, 4, 5, 6, 7, and are discussed in earlier documents.

Phase II of the Cluster Concept Project

The second phase of the project was characterized as having as its chief aims the identification and development of competent teachers for implementing the cluster concept pilot studies.

The following procedures were established and carried out during the selection of teachers for the program:

1. With the approval of the administrators at the State level, industrial education supervisors in the counties

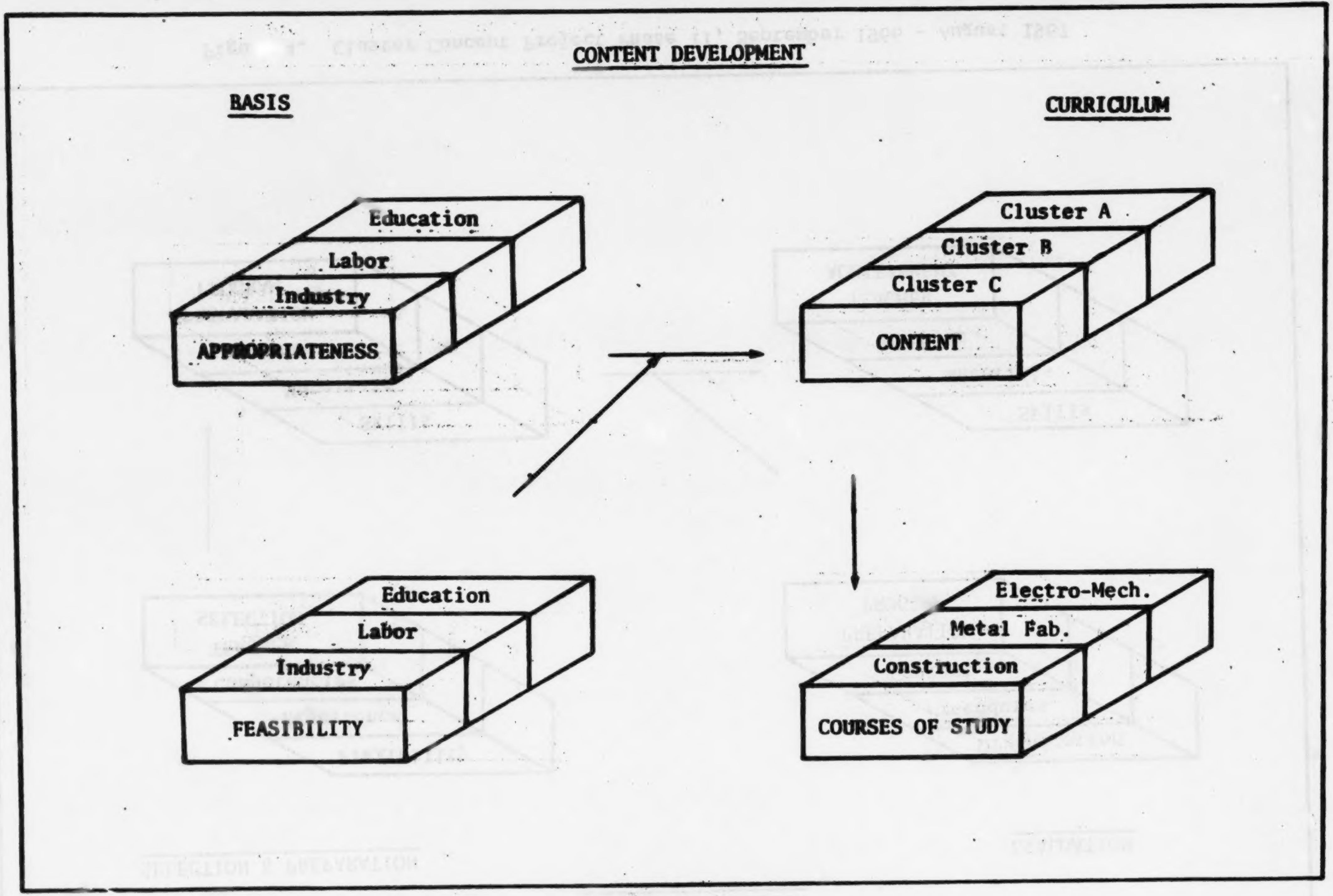

Figure 3. Cluster Concept Project Phase I, September 1965 - August 1966

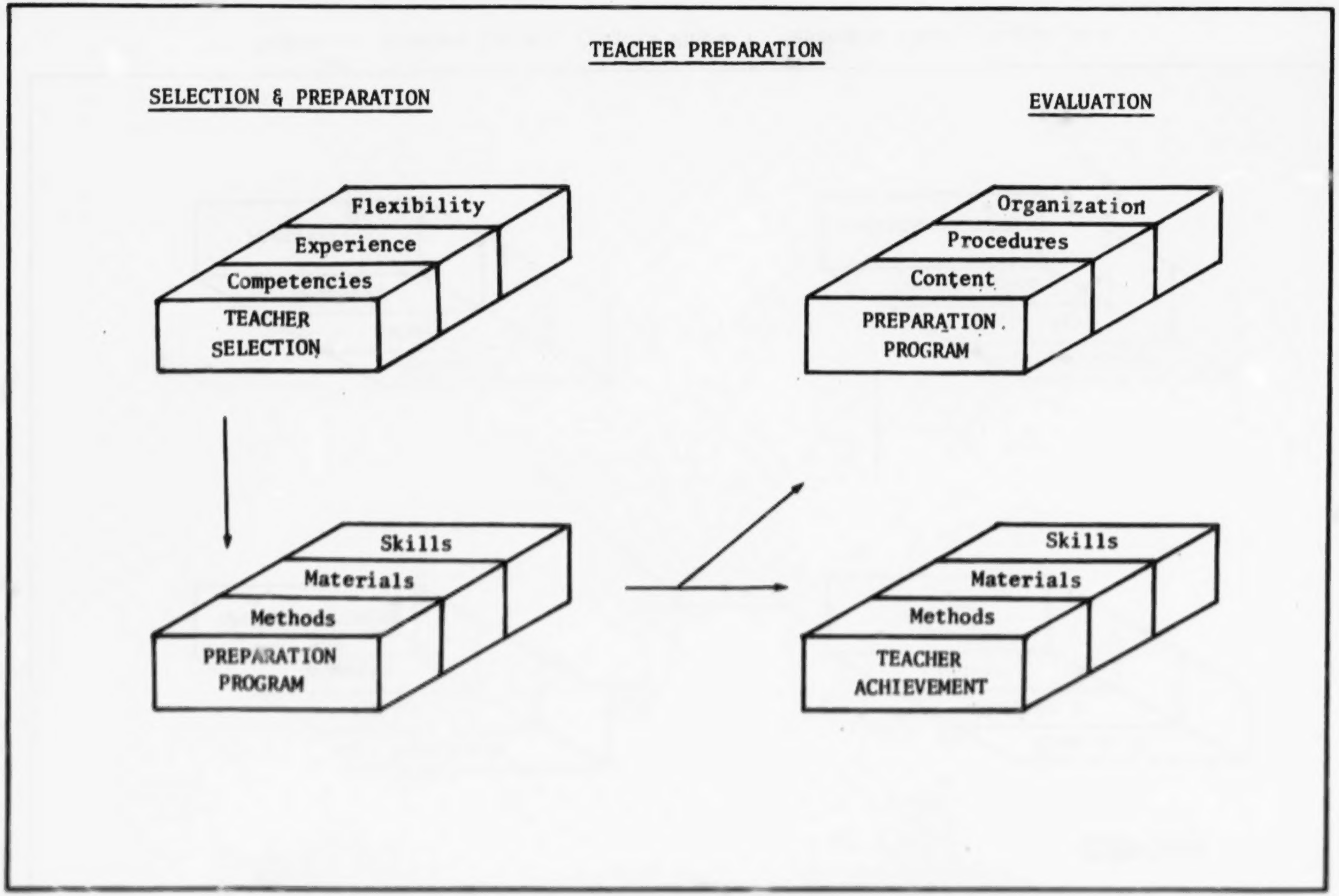

Figure 4. Cluster Concept Project Phase II, September 1966 - August 1967

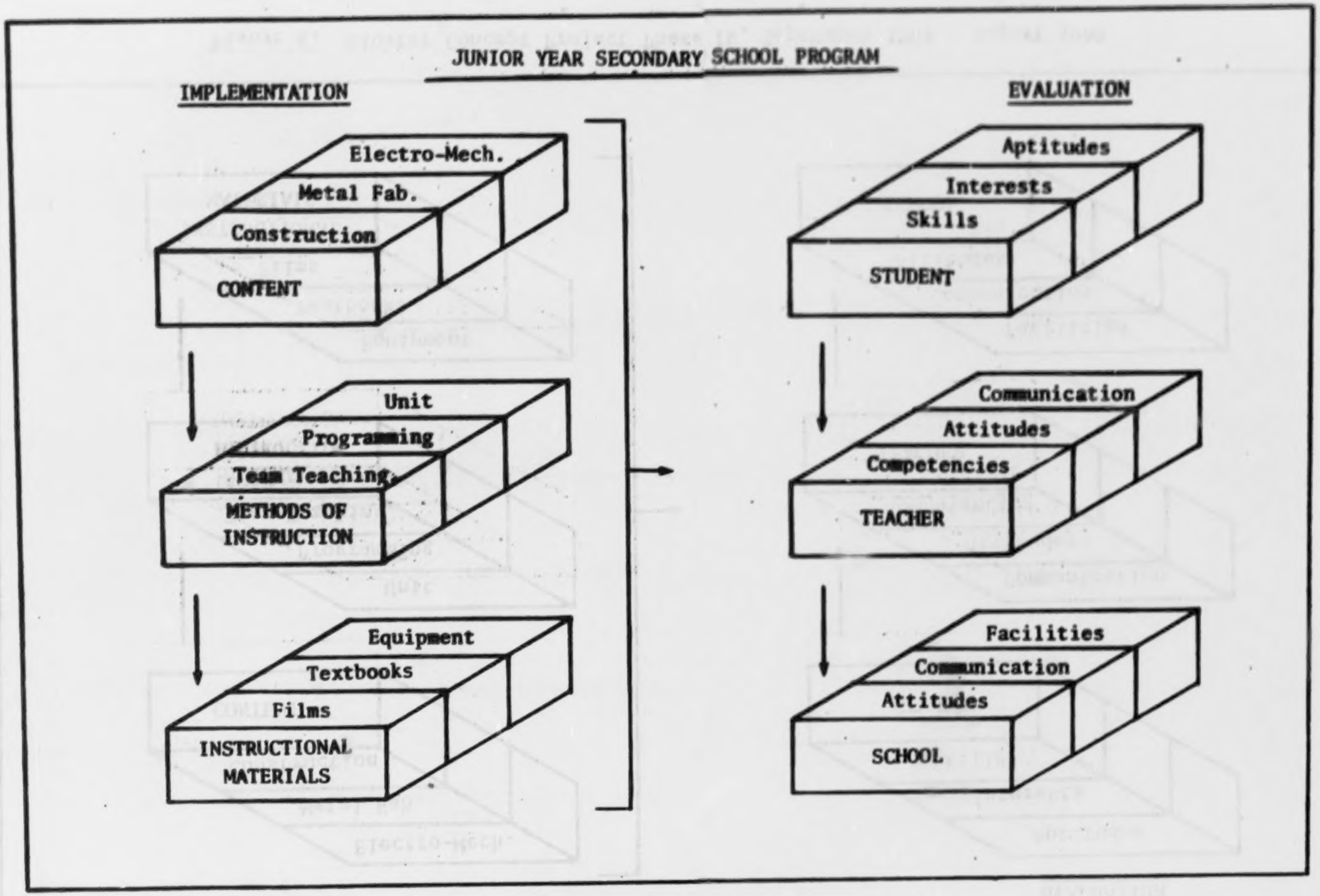

Figure 5. Cluster Concept Project Phase III, September 1967 - August 1968

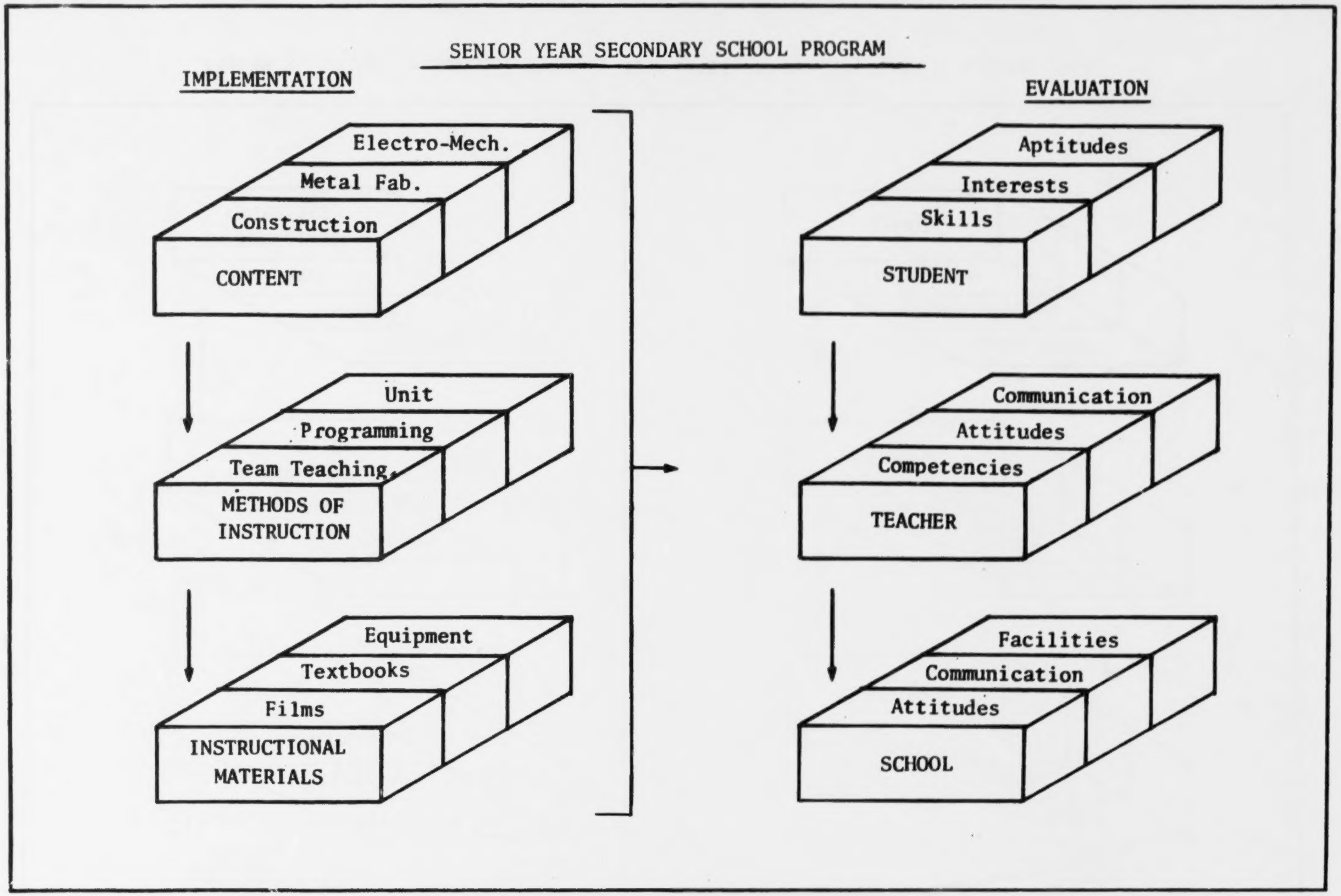

Figure 6. Cluster Concept Project Phase IV, September 1968 - August 1969

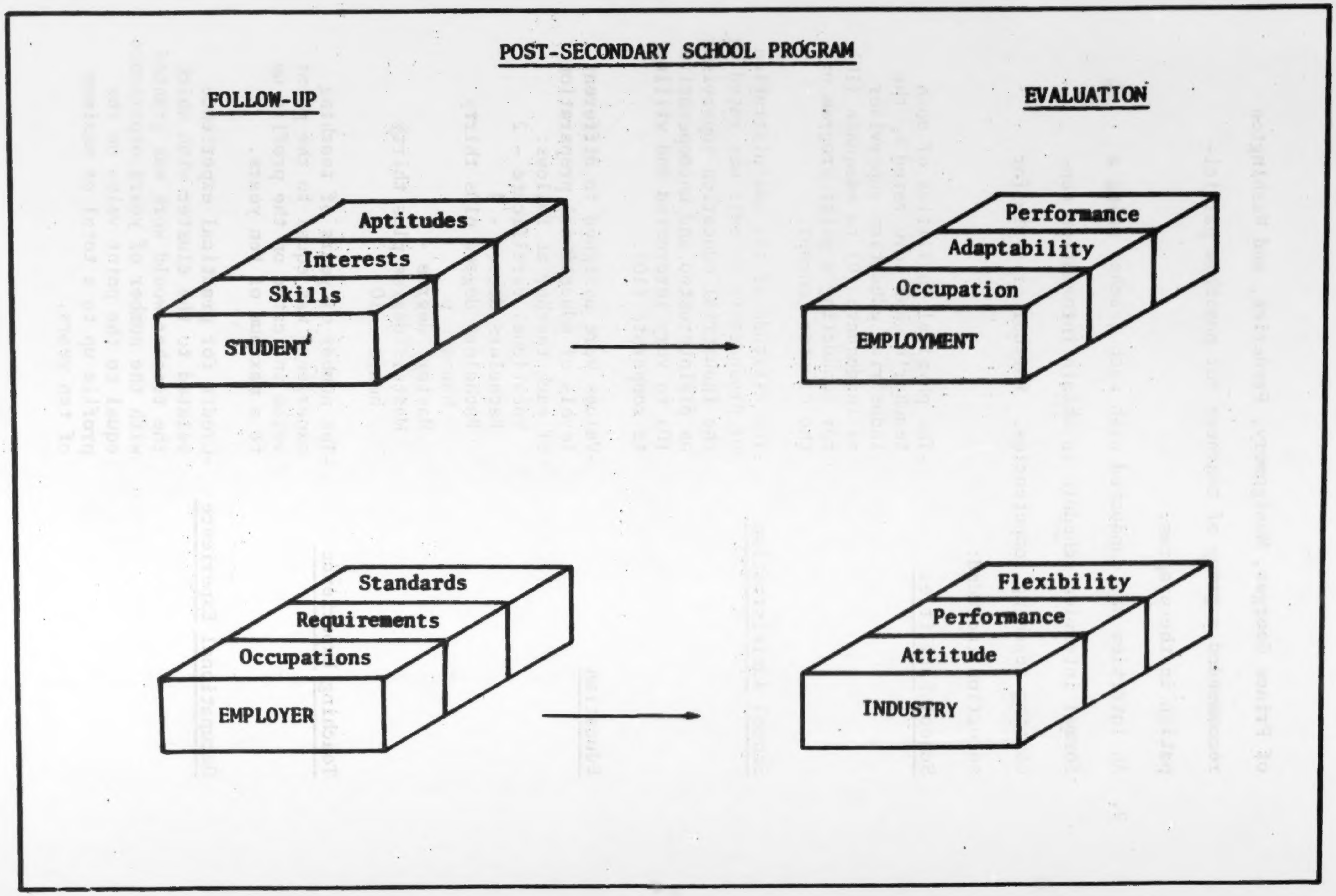

Figure 7. Cluster Concept Project Phase IV (cont'd), September 1968 - August 1969

of Prince Georges, Montgomery, Frederick, and Washington recommended a group of teachers for possible participation in the program.

2. An interview was conducted with each teacher using a formal interview schedule to obtain information concerning teaching competencies. Further criteria for selection included:

School Facilities	-The physical facilities of each teacher's shop were rated by the industrial education supervisor as inadequate (0) to adequate (10) for conducting a pilot program of the cluster concept.
School Administration	-The attitude of the administration of prospective schools was rated by the industrial education supervisor as disinterested and uncooperative (0) to very interested and willing to cooperate (10).
Education	-Values were assigned to different levels of educational preparation of each teacher as follows: Vocational certificate - 2 Bachelors degree - 4 Bachelors degree plus thirty hours - 6 Masters degree - 8 Masters degree plus thirty hours - 10
Teaching Experience	-The number of years of teaching experience was equal to the point value indicated on the profile up to a maximum of ten years.
Occupational Experience	-Credit for practical experience related to the cluster with which the teacher would work was granted with the number of years experience equal to the point value on the profile up to a total or maximum of ten years.

Interview Results	-This was the average of several ratings received by the teacher on the interview schedule; ratings on each factor were from (0-10).
Rokeach Results	-This value was determined by taking one-tenth of the percentile score achieved by the teacher on the Rokeach Test.

3. The Rokeach Dogmatism Scale was administered to the teachers to obtain an indication of an individual's cognitive rigidity and flexibility.
4. A panel of qualified individuals, consisting of the county industrial education supervisors, the assistant director of vocational education for the State of Maryland, the principal investigator and the project coordinator reviewed the data collected for each prospective teacher and selected eleven teachers for participation in the program.

As a result of the above procedure, eleven teachers were selected to receive special training in the cluster concept content and methods.

At the beginning of the Spring semester, 1967, the cluster concept teacher preparation program was initiated. The teachers observed an outlined schedule of attendance and course of studies at the University of Maryland. The activities of the teacher preparation program during the Spring semester included: (1) identifying the strengths and weaknesses of teachers; (2) development of instructional plans for implementing pilot programs; (3) acquainting teachers with instructional materials and equipment that were used in the pilot programs; and (4) arranging the content for each cluster in an instructional sequence, including the areas of human requirement, as required by the specifications established in Phase I.

After careful study and research of the requirements for the cluster concept program, the teachers were evaluated on their competencies and needs. Teacher inadequacies were identified and programs were developed to meet these needs. These programs were carried out on and off-campus during the summer session beginning in June and ending in August of 1967.

In order to secure accurate and up-to-date technical training, industries and governmental organizations were used for establishing cooperating programs.

Some of the principal cooperating organizations were: Sylvania Electric Corporation, Westinghouse Electric Corporation, Tecnifax Corporation, Remington Rand Corporation, Associated Builders and Contractors, and the National Aeronautics and Space Administration.

Final products of phase I and phase II included a teacher preparation curriculum which could be used by others as a guide for developing competent individuals to teach within a cluster concept program, curriculum materials, and instructional plans. These are all available from the officially designated ERIC Center for disseminating research information in the field of vocational-technical education.

Phase III of the Cluster Concept Project

Phase III of the cluster concept research included the term from September 1, 1967 through August 31, 1968. The primary purpose was to evaluate, in a "field setting," the adequacy and effectiveness of the curriculum guides, course outlines, and preparation of the teachers.

The research conducted was characterized as being "aexperimental"[20] where several variables were investigated. As such, it was designed to generate various types of data. Descriptive, comparative, and quantitative data were obtained to assess the impact of the first year of the program on the school administration, teachers, students and adequacy of the instructional materials.

Full control of all the variables necessary for an ideal experiment was not achieved; therefore, phase III was completed in the tradition of quasi-experimental design with full recognition of the factors which render the results equivocal.

Subjects from ten senior high schools in four Maryland counties have participated in this project. One school had two cluster programs, each taught by a cluster concept instructor; thus, eleven teachers and eleven separate cluster programs were included. Each cluster program was compared with a control group composed of students from a traditional vocational education course. Each school was considered and evaluated as a separate experiment.

Problems. To obtain an indirect estimate of the effectiveness of the cluster concept programs, three principal areas of investigation were conducted. These were:

1. The impact of the three cluster concept programs on selected cognitive and affective behaviors, and task performances (psychomotor behaviors) of students.
2. The adequacy and appropriateness of the content of the newly developed course and instructional materials.

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[20] Egon G. Guba, Methodological Strategies for Educational Change, Paper presented to the Conference on Strategies for Educational Change, Washington, D.C., November 8-10, Columbus: School of Education, Ohio State University, 1965 (Mimeo), 33 pp.

3. The educational process, its adequacy and appropriateness with a consideration of administrative support, teacher effectiveness, and selected environmental conditions.

To investigate the first area (1) of research, the changes of behaviors of subjects from the experimental and control groups were evaluated by the administration of a battery of tests at the beginning and at the end of the school year. The tests included newly developed achievement tests for each cluster, the Minnesota Vocational Interest Inventory, the D.A.T. Mechanical Reasoning Test, and an instrument to evaluate the students' knowledge of occupational information.

Treatment of data. Comparability or homogeneity of the students forming both groups was established on the basis of intelligence test scores (lingual or verbal abilities), and in one school, on the Mechanical Reasoning Test. In all but two experiments the analysis of variance statistic was used to determine whether there were significant differences between the two groups on the basis of the derived data. Prior to testing for differences, the F max ratio was used to determine homogeneity of variances. Non-parametric statistics were used in two experiments. The .01 level of significance was considered minimal in all data analyzed.

Findings. Statistical analysis of achievement test data indicated the following:

(a) Three construction cluster programs out of four achieved significantly higher scores than the control group. Three schools also were distinguished as making significant gains on the basis of initial and final scores. One school made very modest but insignificant gains. None of the control groups achieved significant gains on the achievement tests.

(b) All four schools implementing the metal forming and fabrication cluster program made significant gains on the achievement tests; whereas no significant differences were observed from the control groups. All experimental groups achieved significantly higher scores than the control groups on the posttests.

(c) Three schools initially were involved with the implementation of the electro-mechanical installation and repair cluster. Due to many failures to meet the specifications presented, one school operation was discontinued.

Of the two schools, neither achieved significant gains or significantly higher scores than the control group.

(d) Data derived from the D.A.T. Mechanical Reasoning Test (from each of the ten experimental and control groups) indicated that both types of vocational education programs had insignificant effects on the development of the abilities required to solve problems of applied science and technology.

Affective behaviors. Both groups were administered the MVII and the supplementary questionnaire at the beginning and at the end of the school year.

Findings. The data derived from the MVII were perplexing and generally unsatisfactory for a clear group analysis. No clear patterns or directions of student vocational preferences were found. The cluster groups showed more flexibility of occupational choice than did the control groups.

Within the various groups of subjects, it was found that between twenty-five and forty percent of boys were dissatisfied with high school and would prefer to be gainfully employed or to pursue on-the-job training.

The number of students who expressed an appreciation for obtaining broad entry level skills, as opposed to specific in-depth training in high school, increased significantly.

Task performances. In the second (2) area of study, field observations and records of specific overt behaviors of students and teachers were made. The specific behaviors were referred to as job tasks and were set forth in objective behavioral terms. The tasks were incorporated into the course materials, inventory charts, and evaluation charts. The teachers' progress in implementing the instructional materials and student progress was recorded by the use of these devices.

Findings. The range of tasks completed by the instructors of the construction cluster was from 64 to 67 percent. Of the tasks completed from 50 to 66 percent of the tasks were to be restudied by the students.

The metal forming and fabrication cluster group completed from 50 to 67 percent of the tasks. Of these, it was projected that 25 to 34 percent of the tasks should be retaught.

The instructors implementing the electro-mechanical installation and repair cluster completed 50 percent of the tasks. Of these, two-thirds were to be repeated.

The primary cause for the failure to complete specified tasks was due to the lack of equipment, materials, and tools. In some cases teachers tended to overemphasize the areas of studies they favored because of personal bias or expertise. Causes for repeating tasks were: the complex nature of the tasks and the shortage of time for exercises due to delays in remodeling or in setting up laboratories.

The specific units of studies and tasks which have not been studied, or where only token experiences had been provided, were identified.

The third area (3) of investigation was concerned with the evaluation of selected supportive dimensions including: (a) the administration, (b) the teacher, (c) the physical facilities, and (d) community acceptance.

In addition to anecdotal records, the following devices were used to obtain research data: (1) personal vita and records of teachers, (2) survey inventory forms for tools, equipment, and materials for each cluster, (3) drawings and sketches of physical facilities, (4) visual mediums such as drawings, plans, photographs, and written descriptions of practical work performed while implementing the course outlines, and (5) student progress charts, student evaluation charts, and student employment records.

Findings: construction cluster. Administrative support from the state, county, and local levels ranged from enthusiastic verbal support to active participation in overcoming the problems of procurement of physical facilities, materials, and equipment. Since these problems were never fully resolved, various construction tasks were not completed. Consequently, the sequence and balance of the programs were disturbed. Some tasks were overemphasized and in a few situations, omitted altogether.

Various activities of interaction with the community were observed. Resourceful teachers obtained materials from local industries and arranged for student employment during the summer months. One field operation reported job placement of up to ninety percent of the students.

Findings: metal forming and fabrication cluster. Four separate field operations were involved with implementing this type of cluster program. The programs were restricted in different ways and varying degrees due to the lack of equipment and materials. The use of shops which were designed for the study of a single occupation did not provide sufficient working area and in some cases sources of power had to be added. This group of cluster teachers was evaluated to be most effective in meeting the goals and objectives of their respective cluster programs.

Findings: electro-mechanical installation and repair. This cluster program did not escape the damaging effects caused by inadequate supplies, materials, and equipment. The requisition-acquisition time lag strongly suggests that all programs should have been in operation several years before the optimum potential of these programs could be achieved.

One field operation was dropped due to failures in meeting the specifications of the cluster programs.

Summary

The preceding introduction was made to present the continuum of research performed prior to phase IV which is reported in the following chapters.

The completion of phase I (identified as USOE Project Number OE-685-023), established the curriculum for the occupational clusters of Construction, Metal Forming and Fabrication, and Electro-Mechanical Installation and Repair. The completion of phase II (identified as USOE Project Number 6-2312), resulted in the production of curriculum guides, course outlines, instructional materials and the selection and training of the necessary teachers to implement the cluster concept programs in four counties of the State of Maryland. Phase III (identified as USOE Project Number 7-0853), was concerned with the experimental evaluation and implementation aspects of the first year of the cluster concept program. The following pages contain the final report of phase IV. Its major thrust is to provide new knowledge concerning: (1) the operation of the programs in a field setting, (2) the adequacy of the scope, sequence, and timing of the curriculum, (3) the effect on the student, teacher, and the school.

It is important to note that the cluster concept program was designed for the grades eleven and twelve. This report provides an evaluation of the twelfth grade program. Only by the completion of phase IV could the total effect of the new cluster concept program be properly observed and evaluated.

PART II THE REPORT

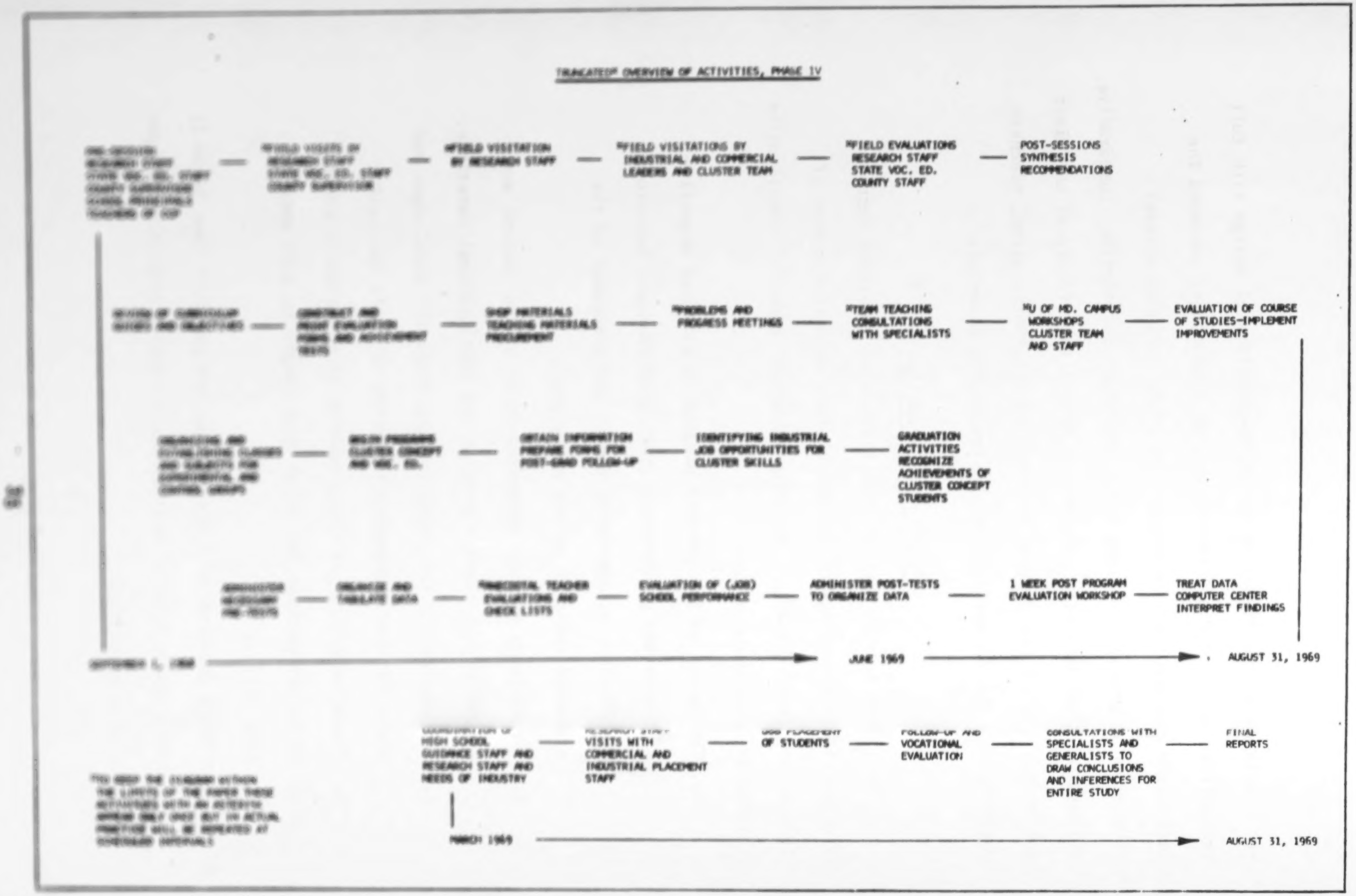
THE STUDY OF THE EFFECTS OF THE SECOND YEAR OF FIELD RESEARCH

Introduction

The following contents of this document (Parts II, III, IV, and V) form the main body of the final report as required under the conditions specified for grant number OEG-08-000853-1865 (085) project number 7-0853. Part II of this report includes: (1) a presentation of an overall plan of activities and problems of the study, and (2) completed findings assessing the effect of the cluster programs on selected behaviors of participating students. Subsequent parts of this report are concerned with the evaluation of pedagogical and selected environmental variables, and finally, the placement of the graduates of the program. (See truncated schematic overview, Figure 8).

The duration of this grant included twelve months, from September 1, 1968 through August 31, 1969. The identifying title for this research is "The Implementation and Further Development of Experimental Cluster Concept Programs through Testing and Evaluation Including Placement and Follow-up of Subjects." This research is further designated as phase IV or the final year of the two-year curriculum.

The problems and methods of procedures included in phase IV are extensions and replications of those described in the final report of phase III. Full control of all the variables necessary for an ideal experiment was not achieved; consequently, the study


TRUNCATED* OVERVIEW OF ACTIVITIES, PHASE IV
PRE-SESSION RESEARCH STAFF STATE VOC. ED. STAFF COUNTY SUPERVISORS SCHOOL PRINCIPALS TEACHERS OF CCP
*FIELD VISITS OF RESEARCH STAFF STATE VOC. ED. STAFF COUNTY SUPERVISION
*FIELD VISITATION BY RESEARCH STAFF
*FIELD VISITATIONS BY INDUSTRIAL AND COMMERCIAL LEADERS AND CLUSTER TEAM
*FIELD EVALUATIONS RESEARCH STAFF STATE VOC. ED. COUNTY STAFF
POST-SESSIONS SYNTHESIS RECOMMENDATIONS
REVISION OF CURRICULUM GUIDES AND OBJECTIVES
CONSTRUCT AND REVISE EVALUATION FORMS AND ACHIEVEMENT TESTS
SHOP MATERIALS TEACHING MATERIALS PROCUREMENT
*PROBLEMS AND PROGRESS MEETINGS
*TEAM TEACHING CONSULTATIONS WITH SPECIALISTS
*U OF MD. CAMPUS WORKSHOPS CLUSTER TEAM AND STAFF
EVALUATION OF COURSE OF STUDIES—IMPLEMENT IMPROVEMENTS
ORGANIZING AND ESTABLISHING CLASSES AND SUBJECTS FOR EXPERIMENTAL AND CONTROL GROUPS
BEGIN PROGRAMS CLUSTER CONCEPT AND VOC. ED.
OBTAIN INFORMATION PREPARE FORMS FOR POST-GRAD FOLLOW-UP
IDENTIFYING INDUSTRIAL JOB OPPORTUNITIES FOR CLUSTER SKILLS
GRADUATION ACTIVITIES RECOGNIZE ACHIEVEMENTS OF CLUSTER CONCEPT STUDENTS
ADMINISTER NECESSARY PRE-TESTS
ORGANIZE AND TABULATE DATA
*ANECDOTAL TEACHER EVALUATIONS AND CHECK LISTS
EVALUATION OF (JOB) SCHOOL PERFORMANCE
ADMINISTER POST-TESTS TO ORGANIZE DATA
1 WEEK POST PROGRAM EVALUATION WORKSHOP
TREAT DATA COMPUTER CENTER INTERPRET FINDINGS
SEPTEMBER 1, 1968
JUNE 1969
AUGUST 31, 1969
COORDINATION OF HIGH SCHOOL GUIDANCE STAFF AND RESEARCH STAFF AND NEEDS OF INDUSTRY
RESEARCH STAFF VISITS WITH COMMERCIAL AND INDUSTRIAL PLACEMENT STAFF
JOB PLACEMENT OF STUDENTS
FOLLOW-UP AND VOCATIONAL EVALUATION
CONSULTATIONS WITH SPECIALISTS AND GENERALISTS TO DRAW CONCLUSIONS AND INFERENCES FOR ENTIRE STUDY
FINAL REPORTS
MARCH 1969
AUGUST 31, 1969

*TO KEEP THE DIAGRAM WITHIN THE LIMITS OF THE PAPER THESE ACTIVITIES WITH AN ASTERISK APPEAR ONLY ONCE BUT IN ACTUAL PRACTICE WILL BE REPEATED AT DESIGNATED INTERVALS

Figure 8.

was completed in the tradition of quasi-experimental design with full recognition of the factors which, in some situations, rendered the inferences and results equivocal. The study included several strategies to generate various types of data. Descriptive, comparative, and quantitative data were obtained to assess the effects of the first and second year of the program on the school administration, teachers, students, and the adequacy of the instructional materials.

Purposes and Problems

The problems investigated were those which provided further evidence of the effectiveness of the cluster concept programs of studies in a field setting. The four principal areas of investigation included the determination of:

1. The impact of the cluster program on selected cognitive, affective and psychomotor (task performances) behaviors, and finally, occupational choice and placement of the graduated subjects of the experiment.
2. The adequacy and the appropriateness of the content and methods of the cluster program and instructional materials.
3. The adequacy of the participating teachers' knowledges and skills for the occupational cluster of their specialty.
4. The employability of the graduates of the cluster program in the occupations for which they sought to gain entry level skills.

A. By completing research with the pretest and posttest (see Table I) with control group type of design, the following cognitive changes of behavior were studied:

1. The achievement or the ability to perform level I and level II tasks identified in the cluster concept courses of study.
2. The student's technical knowledge relative to commonalities of human requirements for various occupations.
3. The student's achievement of knowledge related to the requirements, characteristics, and opportunities of occupational fields within the parameters of the cluster he was engaged in.

B. The affective changes or impact of the cluster concept program on selected vocational interests, vocational preferences and aptitudes were analyzed in terms of trends, shifts, or changes empirically determined. The instruments used are outlined in Table I. The following behaviors were studied:

1. Do students of the cluster program tend to change or extend their vocational choices?
2. Do students of the control or experimental group tend to have stable occupational interests?
3. Will the control or experimental group demonstrate a significant change in vocational aptitudes?

C. Specific performance tasks for level I and level II jobs were identified and catalogued. These tasks were all stated in behavioral terms for purposes of objectivity during evaluations. These task inventories provided:

1. Precise knowledge about the type and kind of manipulative (psychomotor) tasks a student can perform.

TABLE I

VARIABLES OF PRE- AND POSTTESTS

Domain	Instruments	Factors Evaluated
Cognitive	Cluster Concept Achievement Test	Human Requirements* 1. Vocabulary 2. Measurement 3. Skills 4. Math and Science 5. Information
Cognitive	Mechanical Reasoning Differential Aptitude Test (The Psychological Corporation)	Applied science and mechanical reasoning
Affective	Minnesota Vocational Interest Inventory (The Psychological Corporation)	Interest patterns in relation to: 1. Carpentry field 2. Mechanical field 3. Electronics 4. Machinist 5. Painter 6. Plasterer 7. Sheet metal 8. Radio & TV
Cognitive	Occupational Information	Availability Status role Expectations Mobility
Psychomotor	Task Inventory Sheets	Performances of specific tasks derived from manipulative jobs required for each cluster.

*Based on analysis of occupations phase I and II.

2. The parent, teacher, student, and employer had available a complete inventory of the experiences the student had by virtue of completing studies in the cluster programs of his choice.

D. Since the cluster concept program was developed with the aid of industries including similar occupations of each cluster, their aid as well as many others was sought for job placement. The problems investigated were:

1. Was the trend of the rate of employment of the cluster graduates higher than that of traditional vocational programs?
2. After placement on the first job did the students indicate that they had acquired or had the opportunity to obtain the basic entry skills for their occupations?
3. Did the graduates indicate satisfaction, and also what were the future goals or job intentions of the graduates?

Organization of Part II

At the introduction of this chapter or Part II, four major areas of investigation were identified. The remainder of this part includes an elaboration on the principle area 1, whereas 2 and 3 are presented in Part III and area 4 is treated in Part IV.

The second area of investigation has been carried out to assure control and the proper functioning of the programs throughout the year. Feedback information gathered by the visiting research team into the schools operating programs provided descriptive data and a history of pedagogical events recorded by the use of evaluative scales, task charts, and anecdotal records. The various tasks that were structured into the cluster program as expected behaviors of performance were used as an index to determine what had and had not been completed. All of these devices formed a criteria for evaluating instructional materials. This aspect of the study is presented in detail in Part II of this report.

The third area of investigation was concerned with the study of selected supportive dimensions, including the administrative behavior, material and moral support, physical facilities, and teacher effectiveness. These evaluations are presented in descriptive terms; also made, wherever appropriate, was an attempt to quantify certain categories of observed behaviors. Part III of this report contains the specific data, treatment, analysis, and discussion of this aspect of the study.

The Effect of the Cluster Concept Programs on Student Behaviors

To investigate the degree and nature of behavioral changes of students who studied within the cluster concept program, control and experimental groups were established. The experimental groups completed two academic years of training in a cluster program taught by specially trained teachers. For the same interval of time a comparable group, the control group, pursued singular goal-directed vocational courses. Both groups were tested on a battery of pretests and posttests measuring the variables considered central to determining the effect of the experiences gained in the cluster programs. See Table I. The initial administration of the battery was completed in the Fall of 1967 and the final testing was completed in the Spring of 1969. In the interim between these events, the experimental group and the control group studied within their respective courses. The participating teachers were instructed on the proper conduct and attitude to assume to avoid contamination of experimental variables by creating undue competition and by the "Hawthorne Effect."

Control variables were incorporated to assure continuous functioning of the programs and identification of comparable students. Scheduled visitations conducted by the research team and instruction materials served to keep the programs and activities on the proper and prescribed course. Verbal or lingual ability and intelligence scores were obtained from school records to establish a reference point for comparability of the subjects. In several schools these were not available; however, intelligence scores were and these served to form a basis of comparability of students. This is to say that homogeneity between students of the control and experimental group within each school was established either by verbal, lingual, or intelligence scores. No violence was done to the study since each school was analyzed independently. Each school was considered unique in terms of the teacher, type of student, cluster program, and community served.

The dependent and independent and control variables were identified. The treatment or the cluster concept program was the independent variable; whereas the factors evaluated by the tests and presented in Table I are the dependent variables.

Problems Investigated

The problems investigated were those which provided supportive evidence of the effectiveness of the cluster concept in a field setting. The main focus of the following material of Part II is directed on the investigation of the changes of behaviors of students on cognitive and affective variables. By investigating these, an indirect estimate of the adequacy and the effect of the cluster programs was obtained. This part of the report concerns itself with the learning activities, whereas Part III concentrates on the process of teaching and other supportive dimensions.

The effectiveness of the learning process was evaluated in terms of (1) the magnitude of changes observed by data collected, and (2) the number of students who have changed on the variables measured. Specific empirical evidence was sought to answer questions drawn up in a practical manner. The questions for the study of the cognitive behaviors of students were:

1. What were the differences, if any, between the experimental and control groups at the beginning of the study, on variables measured by the Mechanical Reasoning, verbal abilities and the cluster concept achievement tests? Was there any evidence of differences found after two academic years of studies? What were the nature and magnitude of these differences?
2. Did the experiences from studying varied but related occupations facilitate an understanding of the cognitive skills required of students in a cluster program?
3. What supportive evidence was found to indicate that the cluster concept students gained knowledge appropriate to the expectations of the cluster programs?
4. Was there any significant difference in cognitive behaviors between the students of the traditional vocational education classes and the students of the cluster concept programs?

5. Was any statistical evidence found to verify whether the cluster programs facilitated growth in the variables of human requirements? What changes were observed on scores from the mechanical reasoning and cluster concept tests?
6. What generalizations can be advanced about the merits of the cluster concept programs as inferred from the data derived from student cognitive behaviors and task performances?

To investigate the merits of the cluster concept program on the basis of selected affective behaviors, answers to the specific questions were sought. These questions were:

1. Were the interests, as measured by the MVII of the students of both groups, in accord with the courses they chose to study?
2. At the end of the two-year program, which group of students tended to change, shift, or extend their vocational preferences?
3. Does the cluster concept program facilitate changes of preferences within occupations of a cluster or to occupations outside of the parameters of a cluster?
4. Were the changes of affective behaviors in accord with the objectives set forth for the cluster concept program?
5. What generalizations could be advanced regarding the changes of affective behaviors as displayed by the experimental group in relation to the control group?

Instruments Used

As in most cases where the need arises to evaluate a curriculum innovation, new tests must be developed. A thorough search of the available tests for various trades and occupations was completed. No test reviewed possessed the face or content validity suitable for the purposes of this study and as a result, the decision to construct a new instrument was made.

During phase II (1966-1967) the cluster concept teachers developed an expertise in the development of lesson plans for the occupations of a cluster. During the first quarter of phase III these men submitted test items which they believed to reflect the cluster activities outlined in phase II. The cluster research staff reviewed and made statistical analyses of the items. The criteria used for building and reviewing the test items were:

1. The items must be based on the content of the level I and level II cluster programs.
2. The items must require a student to solve a problem or apply knowledges and skills.
3. The items must be practical, emphasizing technical language with verbalism held to a minimum.
4. The items should reflect the level I and level II human requirements as outlined in the courses of study.
5. The items should be of the multiple-choice type adapted to machine scoring.
6. The test should be comprehensive.

To obtain an estimate of the adequacy of the instruments, item analysis and Kuder-Richardson tests of reliability were completed after phase III and IV. These Achievement Tests are presented in Appendix A; some pertinent data derived from investigating the performance of the tests is presented below.

TABLE II

DATA AND RELIABILITY ESTIMATES OF CLUSTER CONCEPT TESTS

Cluster	Items	Subjects	Mean	S.D.	M.D.	Mode	r	r
Construction	86	53	30.72	13.81	36	26	.903*	.883**
Metal Forming and Fabrication	90	66	46.56	13.92	48	35	.923*	.908**
Electro-Mechanical	111	29	47.83	14.23	49	49	.859*	.805**

*Kuder-Richardson Formula 20
**Kuder-Richardson Formula 21

Mechanical reasoning. The Mechanical Reasoning Test[1] which is a distinct and separate part of the D.A.T., produced by the Psychological Corporation, was administered to all groups as a pre and posttest measure. This test purports to distinguish those variables which enable persons to learn the principles of operation and repair of complex devices. Evidence was presented in the manual of the test that it has satisfactory predictive ability for success in vocational subjects. The item content of this test closely reflected some of the knowledges required in the specified human requirements of the cluster concept program.

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[1] George K. Bennett, Harold G. Seashore, Alexander G. Wesman, _Differential Aptitude Test - Mechanical Reasoning (Form A)_, Psychological Corporation, New York, 1947.

The purpose of using this test was twofold. In the event verbal or lingual scores were not available for all subjects, comparability would be established on this test as a criteria. Data from this instrument also provided an index for establishing an estimate of the effect of the cluster concept program on the development of knowledge of applied sciences and technology.

Vocational interests. The Minnesota Vocational Interest Inventory[2] was used by the cluster research project to attain an estimate of the change in occupational interests that took place in students in the course of the two-year experiment. The analysis included both the experimental and control groups, and was concerned with those occupations which are directly related to the cluster concept program.

The MVII, designed essentially to assess the occupational interests of persons at the non-professional level, places primary emphasis on the interests of persons who are seeking employment without having attended college. The inventory is intended to aid counselors working with students and others who are contemplating occupations at the skilled and semi-skilled levels.

The literature related to the MVII reports that it has been administered at the ninth grade level and has been found that the students had no difficulty reading and understanding the items. However, the subjects of this study were found to be under this grade level of reading ability. The author of the MVII stated that this instrument was found suitable for persons of at least fifteen years of age, but the results should be viewed cautiously, since the occupational points of view change quickly between the ages of fifteen and twenty. Although evidence was not available, the author indicated that interests in occupations below the professional level seem to mature at an earlier age than do interests in professional activities.

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[2] David P. Campbell and Kenneth E. Clark, Minnesota Vocational Interest Inventory Manual, New York, Psychological Corporation, 1965, p. 8.

Supplementary questionnaire. A questionnaire was developed to augment the MVII and to obtain a sample estimate of the changes of students' knowledge of occupational expectations. See Appendix B of the final report of phase III. The items were designed to elicit information from students with reference to their knowledge of job opportunities, geographic job mobility, promotional sequence, compensation, required training, job status, and changes due to advancing technology. These questions also reflected the understanding, on the part of the students, of the objectives and goals of the cluster concept programs to fit students for the world of continuous change.

Task inventory sheets. During phase II of the research complete course outlines and instructional materials for each cluster including specific performance tasks and human requirements for level I and level II capability were developed. These were all stated in exact behavioral terms. For a brief review, of the procedures and analyses followed to accomplish the identification of tasks and human behaviors, reference should be made to Part I of this report or the final report of phase II, 1967. A compilation of the tasks for each cluster was made to form an inventory of the specific expectations of the course of studies. A task inventory in a graphic format (See Part III) was used by the teacher as a progress record and by the visiting research assistants as field progress charts to evaluate each school operation. Copies were provided for students and parents, guidance personnel and employers.

Data obtained from these devices provided an objective basis for evaluating each cluster in a field setting and aided in determining the adequacy of the scope, sequence, and timing of the curriculum. A separate task inventory sheet was made for each cluster since each is unique in course content.

Status survey of tools, materials, and equipment. To obtain an estimate of the effort expended in support of the cluster program, survey forms were completed by the teachers. These forms elicited inventory information on the tools, materials, and equipment available at the beginning and at the end of the first year of operations. See Appendix C of the final report of phase III. The information gathered was used to help evaluate each school and was placed into a composite evaluating form.

Composite evaluation form. A composite technique was used to synthesize the evaluated variables of the instructional programs. Complex comparisons were objectified in a verbal and graphic manner. Further objectification was attained by using numerical index on a continuum scale. These forms included an evaluation of administration, teacher, physical facilities, instruction and community involvement. See part III.

Subjects. This research is confined to a population of boys who elected to study in traditional vocational education programs and in the cluster concept programs. The schools in which they pursued these programs were in four counties of the State of Maryland. At the beginning of the experiment students comprising the experimental and control groups were entering the eleventh grade, whereas at the beginning of this year the students were entering grade twelve. Comparability of students within a school was achieved; however, differences on several variables between schools were evident. A few of the obvious differences included: student background experiences, courses pursued in school prior to being included in the experiment, school environment, and industrial orientation of communities.

To avoid confounding the data due to uncontrollable variables, the decision was made to evaluate each school independently. (See limitations of this study). Homogeneity within a school between the experimental and control groups was achieved. In some schools verbal or lingual abilities were used; whereas, in others, I.Q. or mechanical reasoning was the basis for establishing comparability.

In Table III are codified data which obscure the name of the teacher and school and also presents the number of students within each school. In some classes the number of subjects for which complete data was available was slightly lower than the enrollment in class. During the statistical treatment of data occasionally some cases were randomly dropped to expedite calculations. The number of subjects used for statistical investigation is presented in the discussion of the data in the following pages.

TABLE III
TOTAL POPULATION DISTRIBUTION BY CLUSTER, PHASE IV

School	Teacher	Number of students cluster or experimental group	Number of students Number of students control group	Cluster students Graduating
		Construction Cluster		
A	108	14	19	14
H	101	13	19	12
D	102	12	13	4
C	106	5	13	5
	Totals	44	64	35
		Metal Fabrication Cluster		
B	110	16	10	12
E	105	11	10	8
F	111	7	16	4
J	104	12	20	12
	Totals	46	56	36
		Electro-Mechanical Cluster		
M	109	7	15	7
G	107	20	15	4
	Totals	27	30	11
	Grand Totals	117	150	82

Limitations and assumptions. Within research studies which involve social groups, situations are encountered with uncontrollable variables, thereby creating a condition where ideal experimentation conditions are not feasible. Full control of all the variables necessary for an ideal experiment was not achieved; therefore, this study was completed in the tradition of quasi-experimental design with the recognition of the points which would render the results equivocal. The imperfections, limitations, and assumptions included the following partially controlled or completely uncontrolled variables:

1. History of the students: the various combinations of stimuli which contributed to the development of the students prior to becoming a part of the experiment.
2. Maturation: the individual differences in ability to perform tasks due to natural development prior to and during the academic year of research.
3. Personality traits: the attitudes, interests, physical conditions, zeal, motivation on the part of the students, teacher, and administration.
4. Reactive arrangements: students perceive that they are in a different kind of a program and react emotionally in a variety of ways. The psychological disposition to take tests varies from student to student.
5. Restrictive sampling: the teachers who were selected and trained for the cluster program instructed both the experimental and control groups; intact classes were used; random assignment was not achieved.

6. Attendance: the effects of student and teacher observation, time of day, weather, season, and dropouts could not be controlled.
7. School factors: equipment, class size, and general school attitude toward vocational education were varied.
8. Extra-school factors: home life and prevailing attitudes, travel, and parents' occupations.
9. Objectivity: the subjective evaluations of the visiting research teams to the field operations and the activities observed were time representative samples of the teaching-learning situation on days of visitations. No controls could be made during the days of no visitations.

Acknowledging the above limitations, the quasi-experiment to assess the effectiveness of the cluster concept was implemented using the control, independent and dependent variables mentioned in the research design.

Presentation of Data and Findings

Selected Cognitive Variables

Vocational education courses, besides providing training in manipulative performance, must develop appropriate cognitive abilities and proper attitudes. The cognitive variables under investigation were those that are peculiar to the various occupations within the cluster concept programs. As previously described under the heading of instruments, the newly developed cluster tests were used to obtain an estimate of student growth in knowledges and in skills. The mechanical reasoning test which has been reported as a high predictor of success in technical occupations was also used to evaluate the growth of cognitive abilities derived from the applied sciences. These two aspects are presented initially whereas the investigation of affective behaviors and performance of tasks are found in the latter part of this chapter.

The presentation and discussion of the data and findings are presented in the order of considering each cluster and school independently. The problems presented in the previous pages were transformed to researchable hypotheses. The level of significance was set at the .01 level. The determination of the acceptance or rejection of hypotheses provided the substance of information for making inferences about the effectiveness of the program.

Reference should be made to phase III or the final report of 1968 to examine the data relevant to establishing comparable groups, homogeneity on the basis of verbal and lingual abilities, initial differences on various factors and gains in achievement. Research of the first year included a greater number of subjects. During the second year, in some schools, total control groups were dispersed. Maximum and reasonable effort was made to keep the experimental subjects intact. To this extent phase III is more thorough and complete in statistical treatment, whereas different strategies were employed in this report.

To avoid redundance,the four null hypotheses (hypotheses of no difference), applicable to all clusters and schools used in investigating the cognitive behaviors, are stated below.

1. There was no statistical difference in achievement as measured by the cluster concept tests at the completion of the experiment among twelfth grade boys who studied

in the traditional vocational education program.

2. There were no statistical differences in achievement by the control or the experimental group as determined on pre-and posttests measuring knowledge required for the cluster program.
3. There were no statistical differences in mechanical reasoning ability scores at the completion of the experiment among twelfth grade boys who studied in the cluster concept program and those who studied in the traditional yet similar vocational education program.
4. There were no statistical differences in achievement by the control or the experimental group as determined on pre- and posttests measuring mechanical reasoning abilities.

Figure 9 is a graphic representation of the operations conducted to generate data which are presented within both combined reports. The investigation of each field operation is presented independently.

Treatment of Data and Findings

This section of part II deals with the data and findings based on cognitive and affective changes of behaviors in students from which inferences were made about the effectiveness of the program. These are but two aspects of the evaluation and do not enable a comprehensive assessment of the effectiveness of the programs as they were implemented in the field. Due to the many diverse variables impinging upon the pilot programs, the decision was made to evaluate each school operation independently with due consideration of non-experimental events to include descriptive information about the administration, the teacher, the instruction,

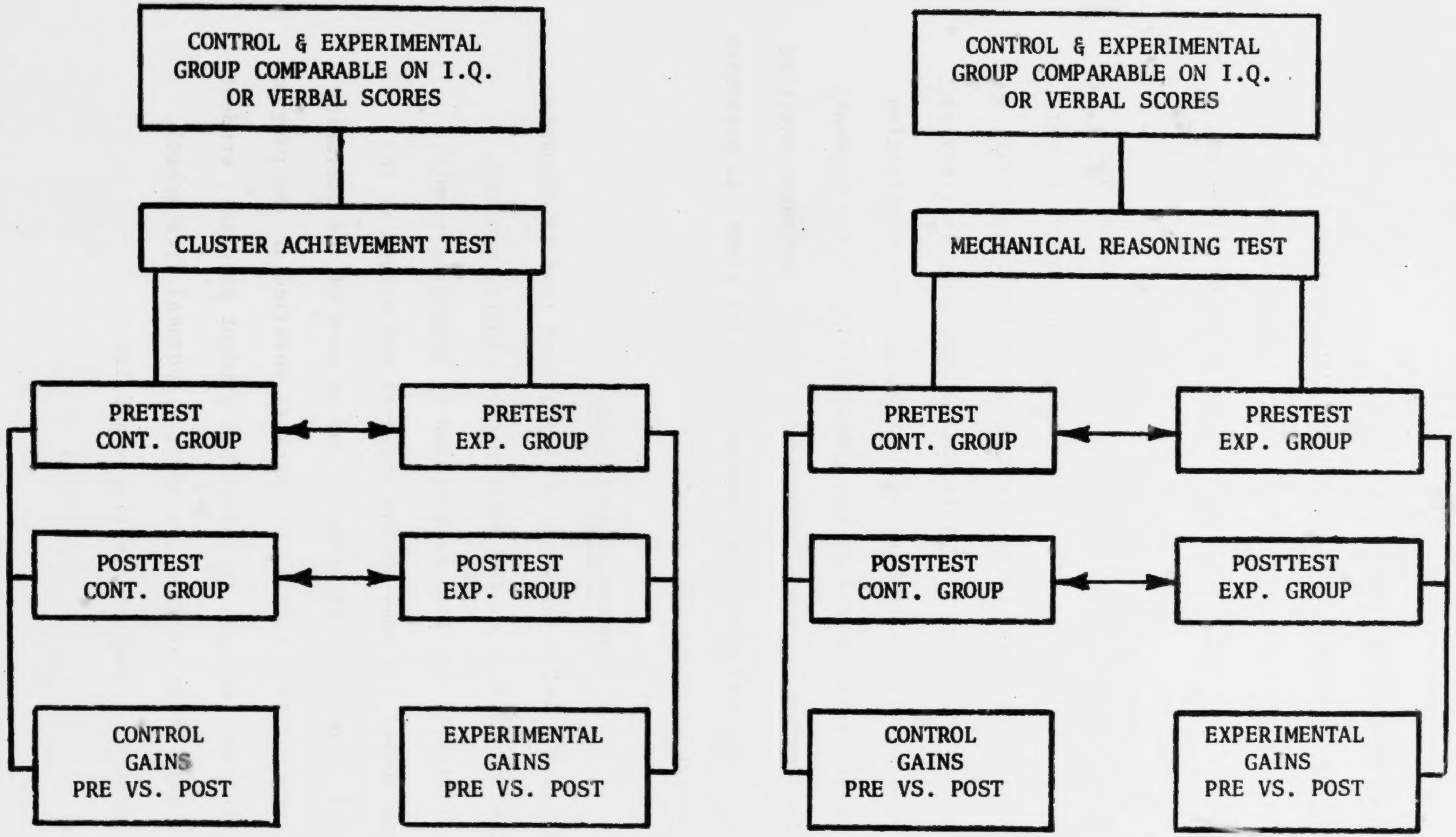
CONTROL & EXPERIMENTAL GROUP COMPARABLE ON I.Q. OR VERBAL SCORES
CLUSTER ACHIEVEMENT TEST
PRETEST CONT. GROUP
PRETEST EXP. GROUP
POSTTEST CONT. GROUP
POSTTEST EXP. GROUP
CONTROL GAINS PRE VS. POST
EXPERIMENTAL GAINS PRE VS. POST
CONTROL & EXPERIMENTAL GROUP COMPARABLE ON I.Q. OR VERBAL SCORES
MECHANICAL REASONING TEST
PRETEST CONT. GROUP
PRESTEST EXP. GROUP
POSTTEST CONT. GROUP
POSTTEST EXP. GROUP
CONTROL GAINS PRE VS. POST
EXPERIMENTAL GAINS PRE VS. POST

Figure 9. Syntagma of Operations Resolving Hypotheses
Phase III; Replicated Phase IV

physical facilities and the community.

Comparability of groups. At the outset, data derived from both the experimental and control groups were investigated to obtain an estimate of statistical comparability of subjects on the basis of intelligence test scores.

In the event the verbal or lingual intelligence test scores were incomplete or unavailable for a satisfactory number of students, comparability was established using the Mechanical Reasoning Test, a distinct and separate part of the Differential Aptitude Test Battery.

A more detailed discussion (including statistical investigation of the homogeneity of variances) of the comparability of the students enrolled in the cluster programs (experimental group) and those enrolled in traditional vocational education programs (control group) is presented in the final report of phase III.

Construction Cluster

At Schools C and D there was a significant loss of students enrolled in the second year of the construction cluster program. Considerable difficulty was also experienced in obtaining complete information and scores for many of the students who served as the original control groups were dispersed. One or more of the following reasons are given for this occurance: seniors enrolled in the program during the first year, changes in individual student programs, student involvement in work-study programs, student withdrawal from school, excessive absences or incomplete testing schedule.

School A. Second year posttest data gathered from subjects of both groups in School A yielded a mean of 40.643 for the experimental group and a mean of 29.214 for the control group. See Table IV. The analysis of variance was used to test the hypothesis that there was no significant difference in the achievement test scores of the two groups. A F ratio of 6.622 was observed. See Table V. This was greater than the table value of 4.22 required for significance at the .05 level. Accordingly, there was a significant difference between the means of the groups and the null hypothesis was, therefore, rejected.

The subjects at School A were observed to be comparable on the basis of intelligence test scores and initial achievement abilities. At the end of the two-year program, the groups were significantly different from each other on the basis of construction cluster achievement test scores. These results were considered as describing a reasonable expectation since the programs of the control and the experimental groups differed in objectives and content.

School C. Scores estimating achievement gathered from School C produced a mean of 28.400 for the experimental group and a mean of 20.500 for the control group. See Table IV. The Mann-Whitney U-Test was employed as the statistical technique to test the research hypothesis that there were significant differences between the data derived from the two groups on the second year posttest of achievement. A z of 1.740 was observed. See Table VI. This was less than the z value of 1.96 necessary to reject the null hypothesis at the .05 level. At School C the data did not support the research hypothesis ; accordingly, the null hypothesis was accepted.

TABLE IV

MEANS AND STANDARD DEVIATIONS DERIVED FROM THE CLUSTER PROGRAM ACHIEVEMENT TESTS 2 YR. POSTTEST

School	Experimental Group			Control Group		
	N	$\overline{X}$	s	N	$\overline{X}$	s
A - Construction	14	40.643	14.779	14	29.214	7.557
B - Metals	12	46.417	10.698	12	36.583	9.765
C - Construction	5	28.400	10.630	5	20.500	18.788
D - Construction	4	23.000	12.083	5	20.500	18.788
D*- Metals	4	58.700	12.369	7	38.700	28.020
E - Metals	4	52.200	14.526	7	32.200	28.020
G - Electro-Mech.	4	55.300	18.868	(No control data available)		
H - Construction	12	29.167	6.191	12	29.833	7.964
J - Metals	12	53.833	8.255	12	34.000	6.060
M - Electro-Mech.	7	45.600	4.899	(No control data available)		

*Teacher F

TABLE V

ANALYSES OF VARIANCE OF CLUSTER CONCEPT ACHIEVEMENT TEST SCORES EXPERIMENTAL VS. CONTROL GROUP - 2 YR. POSTTEST

	Sum of Squares	df	Mean Square	f ratio
School A (Construction)				
Between Groups	914.286	1	914.286	6.622*
Within Groups	3589.571	26	138.060	
Total	4503.857	27		
School H (Construction)				
Between Groups	2.667	1	2.667	0.052
Within Groups	1119.333	22	50.878	
Total	1122.000	23		
School B (Metals)				
Between Groups	580.167	1	580.167	5.530*
Within Groups	2307.833	22	104.901	
Total	2888.000	23		
School J (Metals)				
Between Groups	2360.167	1	2360.167	45.007*
Within Groups	1153.667	22	52.439	
Total	3513.834	23		

*Significant at the .05 level

TABLE VI

MANN-WHITNEY U-TEST SUMMARY TABLES

MANN-WHITNEY U-TEST SUMMARY TABLE EXPERIMENTAL GROUP VS. CONTROL GROUP ON 2 YR. POSTTEST ACHIEVEMENT

School C (Construction)	z = 1.740
School D (Construction)	z = .469
School D* (Metals)	z = 2.453
School E (Metals)	z = 2.111

MANN-WHITNEY U-TEST SUMMARY TABLE EXPERIMENTAL GROUPS VS. CONTROL GROUP ON 2 YR. POSTTEST OF MECHANICAL REASONING ABILITIES (D.A.T.)

School C (Construction)	z = .345
School D (Construction)	z = .462
School D* (Metals)	z = .760
School E (Metals)	z = 1.114

*Teacher F

The rejection region for significance at the .05 level is 1.96.

The subjects at School C were observed to be comparable on the basis of intelligence test scores and initial achievement abilities. However, at the end of the two-year program, the groups were not significantly different from each other on the basis of the cluster achievement test scores.

The means and standard deviations for the experimental students on the pretest, first year posttest, and second year posttest at School C are presented in Table VII .

School D. The derived means from the second year posttest for achievement of the experimental and control groups at School D were 23.000 and 20.500, respectively. See Table IV. The Mann-Whitney U-Test was employed to test the research hypothesis that there were significant differences between the data derived from the two groups on the second year posttest of achievement. A z of .469 was obtained. Since a z value of 1.96 was necessary to reject the null hypothesis at the .05 level, the decision was made to retain this hypothesis. Statistically, there was no significance in the differences among the scores of the two groups.

The subjects at School D were observed to be comparable on the basis of intelligence test scores and initial achievement abilities. However, despite the difference in treatments, at the end of the two years of operation, the two groups were not significantly different from each other on the basis of cluster achievement test scores.

The means and standard deviations for the experimental cluster students on the pretest, posttest after one year, and posttest after two years at School D are reported in Table VII.

TABLE VII

MEANS AND STANDARD DEVIATIONS OF THE CONSTRUCTION CLUSTER STUDENTS DERIVED FROM THE ACHIEVEMENT TEST AND THE MECHANICAL REASONING ABILITIES TEST (D.A.T.)

School	Pretest			Posttest - 1 yr.			Posttest - 2 yr.		
	N	$\overline{X}$	s	N	$\overline{X}$	s	N	$\overline{X}$	s
				Achievement Test					
A	15	29.067	8.738	15	44.467	15.743	14	40.643	14.779
C	12	21.571	5.170	12	28.929	9.161	5	28.400	10.630
D	13	23.538	5.995	13	32.079	14.332	4	23.000	12.083
H	15	23.533	6.105	15	24.867	5.502	12	29.167	6.191
				Mechanical Reasoning					
A	15	40.300	10.099	15	43.000	12.691	14	42.428	15.429
C	12	38.833	9.074	12	47.167	13.855	5	36.400	19.570
D	13	29.692	11.058	13	37.231	11.708	4	33.000	17.205
H	15	30.267	13.014	15	34.807	17.411	12	43.833	10.469

School H. The means and standard deviations for the experimental cluster students on the pretest, first year posttest, and second year posttest at School H are reported in Table VII. Quantitative data obtained from School H at the end of the two-year program included a mean of 29.167 for the experimental group and a mean of 29.833 for the control group. See Table IV. The analysis of variance was used to test the hypothesis that there was no significant difference between the data derived from both groups on the second year posttest of achievement. A F ratio of .052 was observed. See Table V. This was less than the table value of 4.22 required for significance at the .05 level. Consequently, these findings resulted in the retention of the null hypothesis.

The subjects at School H were observed to be comparable on the basis of intelligence test scores and initial achievement abilities. At the end of the two-year program the groups did not differ significantly from each other on the construction cluster achievement test.

Summary Statement of Achievement for the Construction Cluster

The findings of the study supported the hypothesis that the construction cluster program had a significant effect on the cognitive behavior of the subjects in one exemplary program which was School A. This significant effect was determined statistically from data provided by the construction cluster achievement test. This test included items from the field of plumbing, carpentry, painting, electricity, and masonry. The significant effect was interpreted as an indication that the experimental cluster group had achieved the objectives of the construction cluster that were concerned with cognitive development. The control group studied under different objectives; accordingly, the expectations were to observe a divergence in performance if the cluster program was functioning effectively.

At Schools C, D, and H, the research hypothesis that the construction cluster program had a significant effect on the cognitive behavior of the subjects was not supported. Data derived from the construction cluster achievement test indicated that the control and experimental groups did not differ significantly in achievement at the end of the two-year program. Suggested reasons for this occurence are discussed in greater detail in Chapter III of this report. Summarily, however, the experimental cluster students at Schools D and H did not receive instruction in all of the occupational areas. Additionally, instruction in the occupational areas that were taught was, in some instances, inadequate. At School C the program was hampered by the interruption caused by the remodeling of the laboratory. As a result of this restrictive limitation, the students received instruction only in the areas of electricity and masonry during the second year of the program at School C.

Accordingly, it was concluded that the experimental construction cluster programs at Schools C, D, and H did not achieve the objectives of the construction cluster concerned with cognitive development.

Metal Forming and Fabrication Cluster

As in most longitudinal studies there is a loss of subjects. Similarly, there was also a loss of students in both the control and experimental groups in the metal forming and fabrication cluster. The reduction of student population was significant at Schools D and E. At both of these schools students were lost as a result of having had seniors enrolled in the program during the first year of operation and the adjusting of individual programs to meet graduation requirements.

Following the precedent of the final report of phase III of the cluster concept program, the decision was made to apply the analysis of variance statistic wherever it could appropriately be employed. Where this statistical treatment of the data was inappropriate, the Mann-Whitney U-Test was used to test for significant differences among the means of the experimental (cluster) and control (traditional trade and industrial class) groups.

School B. Scores estimating cluster concept achievement at School B yielded a mean of 46.417 for the experimental cluster group and a mean of 36.583 for the control group. See Table IV . The analysis of variance was the statistical treatment employed to test the research hypothesis that there were significant differences between the two groups as measured by the second year posttest of achievement. A F ratio of 5.530 was observed. This was greater than the table value F (4.300) necessary for the retention of the null hypothesis. Consequently, the research hypothesis was supported, and it was established that there were significant differences between the groups on the basis of the cluster achievement test scores.

The subjects at School B were observed to be comparable on the basis of intelligence, test scores and initial achievement abilities. At the end of the two-year program the groups were significantly different from each other on the basis of the cluster achievement test scores.

The means and standard deviations for the experimental cluster students on the pretest, posttest after one year, and posttest after two years at School B are presented in Table VIII.

School D (Teacher F). At School D the means of 58.700 and 38.700 were obtained from the second year posttest data gathered from the experimental and control groups, respectively. The Mann-Whitney U-Test was applied to test the research hypothesis that there were significant differences between the data derived from the groups on the second year posttest of achievement. A z of 2.453 was observed. This z value was greater than the z value of 1.96 required to reject the null hypothesis at the .05 level. Accordingly, the data and findings supported the research hypothesis. There was a significant difference between the scores of the two groups on the cluster achievement test.

The subjects at School D were observed to be comparable on the basis of intelligence test scores and initial achievement abilities. At the end of the two-year experimental program the groups differed significantly on the basis of the cluster achievement test results.

The means and standard deviations for the experimental cluster students on the pretest, posttest after one year, and posttest after two years at School D are reported in Table VIII.

TABLE VIII

MEANS AND STANDARD DEVIATIONS OF THE METAL FORMING AND FABRICATION CLUSTER STUDENTS DERIVED FROM THE ACHIEVEMENT TEST AND THE MECHANICAL REASONING ABILITIES TEST (D.A.T.)

School	Pretest			Posttest - 1 yr.			Posttest - 2 yr.		
	N	$\overline{X}$	s	N	$\overline{X}$	s	N	$\overline{X}$	s
				Achievement Test					
B	16	44.250	10.079	16	50.312	13.583	12	46.417	10.698
D*	15	40.533	12.761	15	49.867	8.331	4	58.700	12.369
E	16	37.500	15.001	16	45.625	10.645	4	52.200	14.526
J	15	49.867	8.733	15	57.000	9.710	12	53.833	8.255
				Mechanical Reasoning					
B	16	30.219	13.848	16	32.350	13.953	12	32.918	12.813
D*	15	32.500	13.023	15	36.900	9.343	4	38.700	11.705
E	16	34.875	11.103	16	39.688	10.309	4	41.700	11.874
J	15	35.323	12.958	15	38.967	11.283	12	40.500	9.777

*Teacher F

School E. The quantitative data obtained from School E at the end of the two-year experimental cluster program included a mean of 52.200 for the experimental group and a mean of 32.200 for the group of students who served as a control group. To test for significant differences between the scores of the two groups, the Mann-Whitney U-Test was applied. This non-parametric statistical test yielded a z-observed of 2.111. This z-observed was greater than the table value of 1.96, necessary for the retention of the null hypothesis that there were no significant differences between the groups as measured by the results of the second year posttest of achievement. Consequently, the research hypothesis was supported. Significant differences did exist between the achievement of the groups on the second year posttest of achievement.

The subjects at School E were observed to be comparable on the basis of intelligence test scores and initial achievement abilities. At the end of the two-year experimental program the groups differed significantly on the basis of the cluster achievement test results.

The means and standard deviations for the experimental cluster students on the pretest, posttest after one year, and posttest after two years at School E are reported in Table VIII.

School J. The derived means from the second year posttest for the experimental and control groups at School J were 53.833 and 34.000, respectively. See Table IV. The analysis of variance was used to test the null hypothesis that there were no significant differences in the cluster achievement test scores of the two groups. Statistical treatment yielded a F ratio of 45.007. The observed F ratio was larger than the critical F ratio of 4.300, necessary to retain the hypothesis. Thus, the null hypothesis was rejected. There was a significant difference between the means of the two groups on the cluster achievement test in favor of the cluster group.

The subjects at School J were observed to be comparable on the basis of intelligence test scores and initial achievement abilities. At the end of the two-year experimental program, the groups differed significantly on the basis of the cluster achievement test results.

The means and standard deviations for the experimental cluster students on the pretest, posttest after one year and posttest after two years at School J are presented in Table VIII.

Summary Statement of Achievement for the Metal Forming and Fabrication Cluster

The findings of this study supported the research hypothesis that the metal forming and fabrication cluster program had a significant effect on the cognitive behavior of the subjects. Supportive evidence was found at all four of the participating schools. The significant effect was determined statistically from data provided by the metal forming and fabrication achievement test. The test estimated cognitive abilities in welding, machining, sheet metal, and assembly. The data was interpreted as an indication that the metal forming and fabrication cluster program objectives concerned with cognitive development had been satisfactorily achieved by the experimental cluster students.

The control group studied under different objectives; consequently, the expectations were to observe a divergence in performance if the cluster program was functioning effectively. While the data indicated effectiveness on this research variable, it was not believed that optimum effectiveness was achieved. Part III provides the evaluation and description of the impediments which, if removed, could substantially improve the results.

Electro-Mechanical Installation and Repair Cluster

Due to circumstances which resulted in a high attrition rate among the students enrolled in the electro-mechanical installation and repair cluster and a near complete loss of the students who served as the original control group, the decision was made to report only the means and standard deviations of the students who participated in the cluster program for the full two years. Proper conditions or prerequisites for statistical treatment were not met; accordingly, any inferences drawn from the findings must be limited to the report of means and standard deviations. Statistical treatment of the first year data is presented in the final report of phase III.

At School M the number of students enrolled in the cluster program dropped from 10 to 7 during the two years of operation. Loss of 3 students was due to the graduation of two of the original students and the withdrawal from school of another. The means and standard deviations for this group on the mechanical reasoning test were: 38.300-10.889, 42.800-9.411, and 43.600-15.362 for the pretest, posttest after one year, and posttest after two years, respectively. See Table IX.

School G suffered a loss of 3 students due to graduation at the end of the first year of the program's operation. Mechanical reasoning test means for this group were 29.000 for the pretest, 35.912 for the first year posttest, and 40.333 for the second year posttest. Standard deviations were 16.086, 15.001, and 22.671 for the pretest, first year posttest, and second year posttest, respectively. See Table IX.

Achievement test means and standard deviations for the cluster students at School M were 46.000-13.767, 50.000-13.912, and

TABLE IX

MEANS AND STANDARD DEVIATIONS OF THE ELECTRO-MECHANICAL CLUSTER STUDENTS DERIVED FROM THE ACHIEVEMENT TEST AND THE MECHANICAL REASONING ABILITIES TEST (D.A.T.)

School	Pretest			Posttest - 1 yr.			Posttest - 2 yr.		
	N	$\overline{X}$	s	N	$\overline{X}$	s	N	$\overline{X}$	s
				Achievement Test					
M	10	46.000	13.767	10	50,000	13,912	7	45,600	4,899
G	7	41.143	11.466	7	54.143	6.817	4	55.300	18,868
				Mechanical Reasoning					
M	10	38.300	10.889	10	42.800	9.411	7	43.600	15.362
G	7	29.000	16.086	7	35.912	15.001	4	40.333	22.671

45.600-4.899 for the pretest, first year posttest, and second year posttest, accordingly. For the cluster students at School G achievement test means were 41.143, 54.143, and 55.300 for the pretest, first year posttest, and second year posttest, respectively. Standard deviations with these means were 11.466, 6.817, and 18.868. A summary of these findings is presented in Table IX.

Summary Statement of Achievement for the Electro-Mechanical Cluster

Both Scholls G and M showed increases in mechanical reasoning abilities. See Table IX. Due to the absence of control data no comparisons of these gains were made. However, these increases could possibly be significant when the total operation of the two-year pilot programs are considered.

School G showed a continuing increase in electro-mechanical cluster achievement for the two-year pilot program. The students at School M showed a slight decrease in achievement on the same measuring instrument. A plausible explanation for this phenomena was highly verbal weighting of the achievement test and its emphasis of abstract problem solving requirements. The students at School M were initially observed to be low in verbal abilities with scores below the average for their age.

Both Schools G and M were found to make increases in the number of manipulative tasks completed. An evaluation of the task performance of the students in the electro-mechanical cluster appears in section III of this report.

Mechanical Reasoning Abilities

The cognitive aspect of this study was limited to those related to knowledges of vocational education presented in the previous pages and a study of the knowledges of applied sciences as measured by the Mechanical Reasoning Test[3], a distinct and separate part of the D.A.T. It was administered to all groups as a pre and posttest instrument. The purpose of using this test was twofold. In the event the verbal or lingual or intelligence test scores were incomplete or unavailable for a satisfactory number of students, comparability would be established on this test as a criterion. Data from this instrument also provided an index for establishing an estimate of the effect of the cluster programs on the development of knowledge from the field of applied sciences. Accordingly, the problems investigated included: Were there any significant differences between the experimental and control groups on data derived from posttest scores? Did the cluster concept programs contribute to or facilitate growth on these variables to a greater extent than the traditional program? What implications do these findings have for the cluster concept programs?

The means and standard deviations for the experimental cluster students' pretest, posttest after one year, and posttest after two years are reported in Tables VII, VIII, and IX. The various F ratios and z's observed for the two-year posttest are presented in Tables VI and X. None of these observed values were significant, indicating that there

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[3] George K. Bennett, Harold G. Seashore, Alexander G. Wesman, "Differential Aptitude Test, Mechanical Reasoning (Form A)," Psychological Corporation, New York, 1947.

TABLE X

MEANS AND STANDARD DEVIATIONS DERIVED FROM THE MECHANICAL REASONING ABILITIES TEST (D.A.T. - 2 YR. POSTTEST)

School	Experimental Group			Control Group		
	N	$\overline{X}$	s	N	$\overline{X}$	s
A - Construction	12	42.428	15.429	14	45.893	14.9874
B - Metals	12	32.918	12.813	12	27.833	10.526
C - Construction	5	36.400	19.570	5	36.400	20.880
D - Construction	4	33.000	17.205	5	22.500	20.880
D* - Metals	4	38.700	11.705	7	27.700	14.629
E - Metals	4	41.700	11.874	7	37.700	14.629
G - Electro-Mech.	4	40.333	22.671	(No control data available)		
H - Construction	12	43.833	10.469	12	47.083	14.755
J - Metals	12	40.500	9.777	12	32.625	10.660
M - Electro-Mech.	7	43.600	15.362	(No control data available)		

*Teacher F

TABLE XI

ANALYSES OF VARIANCE OF DATA FROM MECHANICAL REASONING ABILITIES TEST (D.A.T.) EXPERIMENTAL VS. CONTROL - 2 YR. POSTTEST

	Sum of Squares	df	Mean Square	f ratio
School A (Construction)				
Between Groups	84.009	1	84.009	0.354
Within Groups	6170.018	26	237.308	
Total	6254.027	27		
School H (Construction)				
Between Groups	63.375	1	63.375	0.387
Within Groups	3600.583	22	163.663	
Total	3663.958	23		
School B (Metals)				
Between Groups	155.042	1	155.042	1.128
Within Groups	3024.583	22	137.481	
Total	3179.625	23		
School J (Metals)				
Between Groups	372.094	1	372.094	3.557
Within Groups	2301.563	22	104.617	
Total	2673.657	23		

*Significant at the .05 level

were no significant differences between the control and experimental groups in mechanical reasoning abilities at the end of the two-year program.

The conclusion was made that both types of vocational education (cluster and traditional) made an insignificant contribution to the development of the abilities required to solve problems of applied science as measured by the mechanical reasoning test.

Occupational Information

The evaluation of the cluster program included a consideration of the students' knowledge of related information and job expectations other than the technical skills and knowledges to do a job. All occupations related to the cluster program required the worker to cope with problems of human relations, status, security, advancement, remuneration, change of duties, change of equipment, and sometimes, geographic displacement. In order to obtain an estimate of the students' knowledge and attitude about these factors, a questionnaire was devised and administered as a pre and posttest measure. The questionnaire was also designed to elicit the students' opinion concerning factors dealing with the preparational mode best suited for job entry, characteristics of occupations throughout the country, and occupational choices of the students.

The data derived was summarized into three composite tables, XI , XII , and XIII, each of which was based on one of the above categories of students' reactions. Data for these tables were derived from the Supplementary Questionnaire (See Appendix B, Final Report, Phase III) in which the students selected, in rank order, the three modes of preparation they felt were important for entry into their selected occupation. This questionnaire was administered on three different occasions. The first administration was prior to treatment, the second was upon completion of the first year of treatment and the third administration was upon completion of the second and final year of the cluster program treatment.

As a preference, the completion of high school was by far the choice of the majority of students. While it was a large percentage, it was also evident that a fair percentage of subjects would not prefer to complete high school. Data indicated that between 25 and 40 percent of the students were dissatisfied with the total school program, but not that they would drop out of high school.

On-the-job training as a mode of occupational preparation appeared with considerable strength as the second and third most frequent choice. Twenty-eight percent elected on-the-job training on the pre-measure as a second choice, 30 percent as a second choice at the end of the first year, 45 percent as a second choice at the end of the second year. Twenty-three percent of the students selected on-the-job training as a third choice on the pre-measure, 21 percent at the end of the first year, and 22 percent as a third choice at the end of the second year. See Table XII . The increase in percentage on the first and second year measures were attributed to the orientation of the students to the concepts of: entry level skills, the complexity and diversity of modern industries, and the necessity for on-the-job training.

The apprenticeship program was not selected by any student as a first choice on the pre-measure. It was, however, selected as a first choice by 7 percent of the students on the first year measure, and as a second choice by 23 percent, 15 percent, and 8 percent on

TABLE XII

PREPARATIONAL MODES IDENTIFIED AS MOST IMPORTANT FOR OCCUPATIONAL ENTRY BY CLUSTER CONCEPT STUDENTS

PREPARATIONAL MODES	STUDENT OPINION								
	First Choice			Second Choice			Third Choice		
	Pre-test	1st Yr.	2nd Yr.	Pre-test	1st Yr.	2nd Yr.	Pre-test	1st Yr.	2nd Yr.
	Percent			Percent			Percent		
COMPLETE HIGH SCHOOL	75	60	65	8	9	7	1	6	3
ON-THE-JOB TRAINING	9	11	11	28	30	45	23	21	22
JOB CORPS	0	0	0	2	1	0	4	5	0
NIGHT SCHOOL	1	0	0	2	4	3	6	5	9
ARMED FORCES	1	4	0	11	9	8	9	10	8
TECHNICAL INSTITUTE	8	7	5	5	4	8	12	8	9
EVENING WORK	0	0	3	7	7	4	11	10	4
APPRENTICESHIP	0	7	5	23	15	8	22	13	24
SUMMER SCHOOL	0	0	0	0	1	1	2	3	1
COMMUNITY COLLEGE	2	4	0	10	8	5	6	10	3
OTHERS:	0	0	0	0	1	0	0	1	0

the pre, first year, and second year measures, respectively. A possible reason for this decrease was that many of the students were from rural areas. By virtue of the occupational information from the teachers, the students realized the lack of local opportunities for apprenticeships. It was also suggested that the students realized, after interviewing with possible employers, that entry skills were of high importance and that additional training would necessarily follow after employment.

The slight decrease in the percentage of students electing the completion of high school as essential for job success was observed after the first year. After the second year the data indicated a considerable increase. This was partially explained by the slight shift of preference to other modes of occupational preparation. It was inferred that this shift resulted from the increase in student awareness of the concept that in addition to a high school education, some specialized training is needed to assure occupational success. This awareness was further evidenced by the number of students who considered on-the-job training or attending a technical institute as important factors for future occupational success.

Student occupational choices have been investigated by obtaining data from the same questionnaire. The data is summarized in Table XIII on the basis of pre, first year, and second year measures and first, second, and third choice.

The preference for carpentry within the construction cluster is clearly evident. Several reasons were advanced to explain this observation.

Carpentry tends to have an appeal due to the general familiarity

TABLE XIII

STUDENT OCCUPATIONAL CHOICES BY CLUSTER

OCCUPATIONS	First Choice			Second Choice			Third Choice		
	Pre-test	1st Yr.	2nd Yr.	Pre-test	1st Yr.	2nd Yr.	Pre-test	1st Yr.	2nd Yr.
Construction									
N = 47 Pretest & 1st yr. N = 38 2nd yr.		Percent			Percent			Percent	
Carpenter	38	45	34	17	21	24	13	6	8
Electrician	13	11	13	6	9	13	13	21	18
Mason	17	19	8	23	13	11	6	11	11
Painter	9	9	3	17	21	13	19	15	8
Plumber	4	0	3	2	4	13	17	19	16
Metal Forming & Fabrication									
N = 39 Pretest & 1st yr. N = 25 2nd yr.		Percent			Percent			Percent	
Assembler	0	0	4	5	5	18	10	32	8
Machinist	33	33	32	23	5	20	5	23	12
Sheet Metal Worker	8	3	4	8	18	4	13	10	12
Welder	28	28	24	15	13	28	18	5	0

Table XIII, continued

OCCUPATIONS	First Choice			Second Choice			Third Choice		
	Pre-test	1st Yr.	2nd Yr.	Pre-test	1st Yr.	2nd Yr.	Pre-test	1st Yr.	2nd Yr.
Electro-Mechanical									
N = 15 Pretest & 1st yr. N = 9 2nd yr.		Percent			Percent			Percent	
Air Conditioning	20	13	0	13	13	33	27	27	22
Electrician	20	33	33	13	7	33	20	7	22
Business Machine Serviceman	0	0	0	7	13	0	7	7	0
Home Appliance Serviceman	0	0	0	13	13	22	20	13	11
Radio & TV Serviceman	40	27	56	13	20	0	7	7	11

which most people have with it and also because of the prestige which is accorded to the trade (in some social structures) in relation to the four other occupations. In addition, people have more contact with carpenters in day to day life than with other tradesmen and the occupation has a "clean" connotation when compared to many others. At this time, there was a noticeable demand for carpenters; employment opportunities were excellent. In addition, recent news of an increased hourly wage paid to carpenters of nearly $8.00 undoubtedly contributes to its appeal for the high school student.

The plumbing occupation, to take a direct opposite, was preferred least by the students and all the positive features of carpentry could be turned around and applied negatively towards plumbing, with the obvious exception of hourly wages.

Most of the plumber's work is not visible to the casual observer nor does it have the social status attached to carpentry. There is much less chance of having a plumber as an acquaintance and many people attach the stigma of uncleanliness to the work plumbers do. Two slight changes in second occupational preference were revealed by a decrease in masonry as a first choice and an increase in electrical work as a second choice.

The results of student occupational choices in the construction cluster reveal few real changes in the preferences among the three measures. The results generally tended to indicate a rather static preference for some occupations in comparison to others. This observation suggests that more occupational insight and an appreciation for diverse occupations needs to be pedgogically fostered if it is to be developed.

Fewer observations were possible regarding the metal forming and fabrication cluster although choices again appear to have been made on the basis of limited general knowledge about the occupations. For instance, a noticeable preference was expressed for machinist and welding occupations as opposed to assembly and sheet metal with which high school youths would be less familiar. This assembly-sheet metal phenomenon reversed itself in the second year measure.

The most frequently selected occupations in the electro-mechanical cluster were those about which students were most familiar, such as air conditioning, and radio and television servicing. The occupations of business machine servicemen and appliance repair did not attract as many students as expected. This result again points out the need for additional and more effective occupational information teaching in the program.

In summary, the data from the questionnaire were found to be perplexing with only a modest reflection of the educational experiences dealing with occupational information. The data would support the developmental concept of vocational behavior. The unclear pattern and unequal distribution of choices indicate that deliberate effort must be made by the teachers to study career development patterns and how this relates to occupational information. This must be made a realistic integral part of the course and not a fill-in activity.

The data and information obtained from the supplementary questionnaire (See Appendix B of Final Report, Phase III) concerning occupational characteristics were divided into six specific categories. These categories were obtained by grouping related items of the questionnaire, summarized in Table XIV and discussed below.

TABLE XIV

STUDENT RESPONSES TO SPECIFIED OCCUPATIONAL CHARACTERISTICS

N = 104 Pretest & 1st Yr.
N = 75 2nd Yr.

CHARACTERISTICS	NO			YES			NOT SURE		
	Pre-test	1st Yr.	2nd Yr.	Pre-test	1st Yr.	2nd Yr.	Pre-test	1st Yr.	2nd Yr.
	Percent			Percent			Percent		
1. Jobs preferred available throughout country	88	86	96	5	10	1	7	5	0
2. Resident displacement required	26	23	21	40	42	52	20	25	27
3. Vertical advancement within job available	79	74	77	9	12	7	12	14	15
4. Broad background is needed	70	66	68	15	18	16	14	15	16
5. Occupations require growth on job	67	62	69	6	13	15	27	25	16
6. Prefers present area for living	57	44	69	21	18	12	22	30	19
7. Long range salary improvement available	76	77	92	20	13	4	4	3	4
8. Preference of interest over money	13	16	32	53	57	50	13	17	18
9. Expects tool and skill changes	65	66	70	12	11	9	22	23	20
10. Needs broad training rather than for specific job	75	74	73	13	12	15	12	14	12
11. Job skills are more important than human relations	60	59	60	20	22	24	17	16	21
12. Status or prestige associated with job	59	64	73	8	8	5	32	27	0
13. Use job as stepping stone	35	47	34	28	21	22	38	32	44
14. Expects to stay on initial job	69	74	65	14	13	14	16	12	22
15. There is vertical mobility within the field	53	58	58	18	12	7	29	31	36
16. Specialize in one trade for success	28	33	33	34	28	30	31	30	36
17. Choose job whose technology doesn't change	24	23	32	58	56	49	14	17	19

Geographical Mobility

Items 1, 2, and 6 (See questionnaire, Final Report, phase III or Table XIV) related to the area of geographic mobility and provided data which indicated that students' attitudes did change somewhat in the course of the two-year program. However, there was a noticeable change in their preference for employment within the immediate vicinity of their home. The pre-test showed a high preference for remaining near their home, the first year measure showed a decrease and the second year revealed a definite increase in their desire to remain near home. The social determinants for this behavior were not investigated. It is interesting to note that they have this desire even though they believe the jobs are available throughout the country. This does parallel, however, with their response to item 8 which indicated that they have placed intrinsic values ahead of money. Since most students came from neither deprived nor high income backgrounds, it may be said that there is a tendency for boys to regard intrinsic rewards as important. This dimension should be studied as a determinant in relationship in relationship to extrinsic values.

Nature of Work

Item 17 yielded data indicating some change of attitude among students regarding occupational technology. Almost all of the students felt, on the pre-measure, that technological advances would have an effect on the occupation of their choice, and indicated their willingness to accept and keep up with the changing technology. It was clear that students favored advances in technology.

Vertical Mobility

Items 3, 5, 13, and 15 provided evidence that all students tended to realize that experience and success in an occupation under the right conditions may lead to advancement and perhaps new employment and promotions within a company.

Students' attitudes toward vertical mobility within selected occupations revealed that many of the students expected to change jobs within a company or to another company rather than remain at one for an extended period of time. This can be interpreted to mean that students are considering long-range plans. These attitudes remained relatively stable throughout the two years.

Change of Interest

Items 9 and 14 were related to the students' understanding and anticipation of his own changes of interest and motivations relating to occupational choice. Most students realized that technological changes will result in the development of new tools and equipment which they will have to use to perform in their selected occupations. They also realized that their interest in other occupations, plus instruction in these areas would enable them to leave one specialized vocation and seek employment in a related occupation, and that this was an expected process of career development. The students remained virtually unchanged in these attitudes throughout the program.

Personal Satisfaction

Items 7, 8, and 12 were related to factors dealing with money, interest or status in relation to selected occupations. Most students indicated their interest in well paying jobs on the pre-measure, and the expectations of increased earnings with experience. Most students also selected occupations which were socially acceptable and carried an average amount of status. In the second year measure the most noticeable change was in the students' attitude toward the interest-money relationship. The increase was toward interest and satisfaction by the performance of certain tasks.

Realistic Preparation

Items 4, 10, 11 and 16 provided data which indicated that most students appreciated the need for entry level training which would enable them to enter different occupations as opposed to specialized training in a specific trade. Students also indicated that the ability to get along with people on the job and other social adjustments are more important than knowing every detail of the job.

The response of the students, while in school, tended to be, in a measure, artificial. It is quite possible that motivation forces of various types have yet not reached the conscious awareness of the subjects. It is quite possible that the questions asked were still highly hypothetical and that if they were to enter a job not high in their present preference, that psychological job satisfaction would emerge as their needs for financial independence would be met. Thus, they might realize that their alternate choice of a job can be to some measure satisfying. A follow-up study has been proposed and it is expected that information on this problem can be obtained.

Affective Behaviors

The point of view taken in this study was that no single source of information would provide an adequate basis for making comprehensive decisions about the effectiveness of and suggestions for improving the cluster program. Since the program is vocational in nature, it was decided that occupational interests of the subjects must be investigated. Study of deeper determinants such as job perception, maturity, perceived needs and self constructs were excluded.

To investigate the occupational interests and what changes of interests occur, if any, the Minnesota Vocational Interest Inventory[4] was administered at the beginning and at the end of the school year to all subjects included in this study. After a study of the various available instruments, it was decided that the MVII was applicable to this study because to some degree it evaluated interests of semi-skilled and skilled occupations.

The subjects included in this research ranged in ages from fifteen to nineteen. According to the suggestions of the author of the MVII, all results derived should be viewed with judgment and some reservation since it was found that student interests change to some extent at this age and do not stabilize in many cases until the age of twenty-five. However, the author also stated that a greater degree of stability was found among individuals of the skilled and semi-skilled occupations than in individuals of the professions. From the data gathered it became evident that students of this study did change their attitudes towards selected occupations. There were no overall clear patterns or directions of changes in interests. In some, the change was clearly in the direction of the courses in which they were enrolled, whereas, in others, the inverse was observed. This effect was observed after the second year measure, as well. The subjects of School A, a construction cluster, generated a total sum change score of 8.4 points in the direction of those occupations related to the cluster concept on the first year measure, and 32.3 negative movement at the end of the second year; whereas, the derived overall change score made by School H, also of the construction cluster, was 16.7 points in a negative direction from the cluster program on the first year measure and positive movement of 11.5 on the second year measure. A more deliberate study investigating the determinants of these variances should be conducted. For the purposes of meeting job perception and self constructs of students, the data suggested more attention should be given to guidance and occupational information.

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[4] David P. Campbell, op. cit.

Data derived from students of the traditional vocational education program provided evidence to indicate that the changes that have taken place were similar after the one year measure. This can be observed by studying the data derived from the control groups of School M and D. Second year data were not available for the subjects of the traditional vocational education program.

Traditional programs required a decision on the part of the students to study a specific occupation in a unit shop. The data gathered after one year of exposure indicated that these students were characterized as being ambivalent in their occupational preferences. Accordingly, as evidenced by the data collected, the expectation of requiring a student to make a commitment to an occupation at this stage of his development is questionable.

The fluctuation of student interests are represented in Table XV. The differences in quantitative values could be attributed to chance and/or error of the instrument. However, the data indicated that student interests did change within an interval of time of one academic year. Findings such as this lend support to the concept of clustering occupations into which students can achieve entry level skills over a shorter period of time rather than in-depth programs of long intervals of time. The cluster programs encourage flexibility by providing more degrees of freedom for the natural changes of interests of youth, whereas, the traditional programs, and yet unidentified socio-psychological variables, restrict or confine student interests towards a goal set in the early years of high school. Information with emphasis on individual variability and dynamisms of vocational choice, and sociological study of group variability provided to students in some phase of their high school education would be in order.

TABLE XV

RESULTS OF SELECTED EMPIRICAL AND HOMOGENEOUS SCALES FROM THE MINNESOTA VOCATIONAL INTEREST INVENTORY

School A Construction Cluster

	Significant Result*	Pre Average Score	1st Year Average Score	2nd Year Average Score
Carpenter	41+	40.7	40.2	36.7
Painter	39+	35.1	37.5	35.0
Plasterer	37+	31.1	31.6	30.4
Plumber	39+	33.7	36.9	27.2
Electrician	33+	33.1	31.8	22.5
Mechanical		58.0	56.2	51.1
Carpentry		44.1	50.4	50.4

School C Construction Cluster

	Significant Result*	Pre Average Score	1st Year Average Score	2nd Year Average Score
Carpenter	41+	41.5	32.9	38.7
Painter	39+	30.1	29.8	36.2
Plasterer	37+	31.4	36.0	32.0
Plumber	39+	26.1	24.9	21.6
Electrician	33+	18.8	16.0	22.5
Mechanical		47.5	45.3	50.8
Carpentry		52.8	49.5	47.0

*The student has interests similar to those people working in the occupation if his socre is higher than this value.

**A score of 25 or less indicates student has few interests similar to those in the occupation.

Table XV, continued

School D Construction Cluster

	Significant Results*	Pre Average Score	1st Year Average Score	2nd Year Average Score
Carpenter	41+	32.0	31.4	32.8
Painter	39+	30.4	29.5	35.5
Plasterer	37+	32.3	33.3	29.0
Plumber	39+	28.7	28.8	14.5
Electrician	33+	19.0	19.6	17.2
Mechanical		42.1	40.2	37.8
Carpentry		55.1	31.4	45.8

School H Construction Cluster

	Significant Results*	Pre Average Score	1st Year Average Score	2nd Year Average Score
Carpenter	41+	45.8	38.1	32.8
Painter	39+	37.5	38.4	37.6
Plasterer	37+	33.1	32.2	32.4
Plumber	39+	28.7	25.6	25.6
Electrician	33+	22.7	18.7	21.6
Mechanical		47.8	48.6	44.7
Carpentry		55.1	51.7	49.0

*The student has interests similar to those people working in the occupation if his score is higher than this value.

**A score of 25 or less indicates sutdent has few interests similar to those in the occupation.

Table XV, continued

School B Metal-Forming & Fabrication Cluster

	Significant Result*	Pre Average Score	1st Year Average Score	2nd Year Average Score
Sheet Metal Worker	41+	40.0	35.3	61.0
Machinist	38+	31.9	30.1	52.2
Mechanical		46.6	44.8	87.4

School E Metal-Forming & Fabrication Cluster

	Significant Result*	Pre Average Score	1st Year Average Score	2nd Year Average Score
Sheet Metal Worker	41+	28.8	32.7	No Data
Machinist	38+	35.5	30.1	
Mechanical		42.6	40.0	

*The student has interests similar to those people working in the occupation if his score is higher than this value.

**A score of 25 or less indicates student has few interests similar to those in the occupation.

Table XV, continued

School D Metal-Forming & Fabrication Cluster

	Significant Result*	Pre Average Score	1st Year Average Score	2nd Year Average Score
Sheet Metal Worker	41*	33.4	27.7	29.4
Machinist	38*	35.1	32.0	32.5
Mechanical		45.3	40.7	40.2

School J Metal-Forming & Fabrication Cluster

	Significant Result*	Pre Average Score	1st Year Average Score	2nd Year Average Score
Sheet Metal Worker	41+	39.1	39.5	34.0
Machinist	38+	30.1	30.1	30.4
Mechanical		51.4	46.9	44.8

*The student has interests similar to those people working in the occupation if his score is higher than this value.

**A score of 25 or less indicates student has few interests similar to those in the occupation.

School G Electro-Mechanical Cluster

	Significant Result*	Pre Average Score	1st Year Average Score	2nd Year Average Score
Electrician	33+	27.8	28.2	42.3
Radio & TV Repair	33+	31.6	34.2	38.8
Mechanical		43.6	42.4	50.0
Electronics		54.8	55.6	65.3

School M Electro-Mechanical Cluster

	Significant Result*	Pre Average Score	1st Year Average Score	2nd Year Average Score
Electrician	33+	30.2	27.5	26.2
Radio & TV Repair	33+	37.0	34.5	37.8
Mechanical		47.2	40.8	43.8
Electronics		55.0	50.2	51.6

*The student has interests similar to those people working in the occupation if his score is higher than this value.

**A score of 25 or less indicates student has few interests similar to those in the occupation.

PART III

EVALUATION OF CLUSTER CONCEPT PILOT PROGRAMS

Introduction

In accordance with the premise that education is the process of changing student behaviors, the report requires at this point an evaluation of the process of education. The understanding of and improvement of the process can advance the cluster program to new dimensions. The evaluation of the effect of the cluster program on the student has been presented in Part II. For a lack of a rigorous, quantitative methodology to evaluate the dynamic process such as the art of teaching, the methods resorted to were: visitations, gathering of data by observations, and rational interpretation of events. The efforts of evaluation were directed toward the consideration of the administration, the teacher, instruction, physical facilities, equipment and, in a limited way, the community.

Limitations. The following descriptive data, check lists, and written evaluations were generated by the visiting research team. Subjective interpretations and diagnosis of field operations based on scheduled visitations were known to have limitations. Every effort was made to gather information on objective and observed behaviors. No attempt was made to explain causes for teacher or administrative behaviors. The events and situations as they were observed were the targets of the visiting teams.

Field evaluations. Visitations to the participating schools were conducted by two groups at different time intervals. One group was composed of an administrator from the State Department of Vocational Education, the county supervisor of vocational education, the principal investigator, the research coordinator and the high school principal. This group was considered the supervisory team for the project, whereas the cluster research team (the four research assistants) provided special assistance and guidance for the implementation and evaluation of the new program. The schedules for these visitations were presented in all of the quarterly reports submitted to the U.S. Office of Education.

The evaluations in the field were conducted with due consideration to the objectives of the cluster concept program and the specific tasks which were stated in behavioral terms. The tasks were built into the course work and evaluation check lists. To perform the evaluation of selected factors of the educational process, the following activities were completed:

1. Scheduled bi-weekly visitations were planned to include: teachers, supervisors, research assistants, project coordinator,and principal investigator.
2. Special seminars were conducted for the purpose of enabling the field teachers to share problems and solutions associated with implementing the cluster concept program.
3. A special all-day seminar including representatives from the State Department of Education, four county supervisors, high school principals, guidance workers, assistant principals, and curriculum specialists was held early in the school year to plan and to take the steps necessary to implement the second year of research.

Construction Cluster

The construction cluster was designed to develop within the student skills and understandings required in the occupations of carpentry, electricity, masonry, painting, and plumbing. The program was not designed for in-depth development of skills in one specific occupation, but aimed at preparing students to enter any of the occupations within the construction cluster.

Course Objectives

The following objectives served as goals for the construction cluster curriculum:

1. To broaden the student's understanding of the available opportunities in occupations within the parameters of the construction cluster.
2. To develop job entry skills and knowledge for all of the identified occupations found in the construction cluster.
3. To develop a favorable attitude toward work activities and the problems of the construction cluster.
4. To develop a student's understanding of the sources of information that will be helpful to him as he moves through the occupational areas, in and out of school.

The specific objectives for the course are the following:

1. To develop the student's competency in the use of necessary hand tools found in the construction cluster.
2. To develop the student's competency in using power tools and equipment needed for job entry into the occupations found in the construction cluster.

3. To develop the student's understanding of the operations, procedures, and processes associated with the construction cluster.
4. To develop safe working habits related to the occupations within the construction cluster.
5. To familiarize the student with the terminology associated with the construction cluster.
6. To develop an understanding of the resources available to him in his pursuit of the course as well as in his work following graduation.

Plan of Presentation

In the following section of the report the pilot program of each school will be discussed with reference to the administration, the teacher, the physical facilities, the instruction, and community involvement.

The information reported was obtained by members of the cluster concept project research team through a series of bi-weekly visitations to the various schools that conducted pilot programs in the construction cluster.

Orientation. School A was located in a rural setting and was composed of grades 7 through 12. The school program consisted of the basic general education courses for grades 7 and 8. Students entering grade 9 selected a program to be followed for the remainder of their high school career. The students selected either the college entrance, business or general curriculum.

The introduction of the construction cluster into this school added another dimension to the practical arts curriculum. In addition to the construction cluster the other practical areas of the curriculum included courses in business, home economics, industrial arts and agricultural education.

The administration. The principal of School A was exceptionally enthusiastic about the cluster program and was instrumental in helping Teacher A obtain the necessary equipment and materials needed to conduct his program.

Both the principal and the guidance counselor aided Teacher A with problems involving scheduling of students and class time, and with obtaining additional physical facilities in which to conduct certain phases of the program.

The county administration, while favoring the idea of the cluster concept program, provided Teacher A with only minimal support until rather late in the school year. Most of the supplies and materials secured during the school year were obtained on emergency requisitions requested by Teacher A or his principal. Textbooks, which were ordered in the Spring of 1967, were received during the school year. In the Spring, Teacher A was allotted a sum of money by the supervisor of industrial education which was to be spent by the end of the school year. Requisitions for equipment, supplies, and materials were filled out; some of the requested items have been received. See inventory check list in Appendix C.

The supervisor of industrial education was informed by letter of the scheduled visitations with the cluster concept project teachers in his county, but he could only attend one of the scheduled visitations conducted at School A. Teacher A had little communication with him during the school year. Most of the communication was initiated by Teacher A due to urgent needs for materials, equipment, and textbooks.

The teacher. Teacher A's education consisted of B.S. and M.A. degrees in Industrial Education. Teacher A had ten years teaching experience at the junior and senior high school level. In addition to three years of experience working for a general contractor as a carpenter, painter, and electrician, Teacher A had built his own home.

The research team concurred that Teacher A exhibited outstanding leadership, enthusiasm, initiative, and teaching abilities. He encouraged his students to succeed in various areas of construction. In doing so, most of the manipulative tasks of the cluster concept program were successfully performed. See the task evaluation chart of student competencies at the end of this section.

Throughout most of the school year Teacher A was faced with shortages of supplies, equipment, and materials needed for his program. Through his efforts and those of his principal, the resources of the county, the community, and the school system were utilized in order to secure the necessary materials needed to conduct the cluster program. Several building supply dealers furnished plumbing fixtures and used lumber free of charge. In cases where needed, and where tools and materials could not be obtained any other way, the principal of School A procured them with emergency requisitions.

Physical facilities. In the second year of research, fifteen boys were enrolled in the construction cluster in School A. The class met in the agricultural laboratory and utilized the equipment in this facility. This laboratory was of adequate dimension to accommodate the classes; however there was not enough space for storage of tools and supplies.

In order to provide the needed storage space and additional work area, the first project of the construction cluster class was to build a 24' X 24' building adjacent to the laboratory. This building also had a 24' X 24' concrete slab adjacent to it which was utilized as a work area when the weather permitted.

A status survey of tools, materials, and equipment revealed that during the course of the 1967-1968 school year, approximately 25 percent of the recommended items were obtained. Another 35 percent was obtained during this year. The tools and materials needed for the construction of a greenhouse were obtained on an emergency requisition through the cooperation of the principal of School A.

A detailed drawing of the laboratory in which the construction cluster was conducted was presented in the final report of phase III. This drawing also indicated major pieces of equipment and their location in the laboratory. The suggested configuration as envisioned by the research team is shown in Figure 10.

Instruction. Among the class activities of School A were the construction of a greenhouse for the agriculture department, an athletic storage facility, large tool boxes, bookcases, trailer beds, metal storage racks, work horses for installing dry wall, a pre-fabricated garden tool shed, park picnic tables, and a cow feeder. During the year, individual students constructed several small projects as well as performed single task exercise operations. These activities were designed to provide learning experiences incorporating occupational tasks of the construction cluster. A photograph of one of these projects is shown on page 103. The students at School A received many varied experiences in the construction cluster. Exercises, small projects, and large projects were used to promote the learning of the tasks,

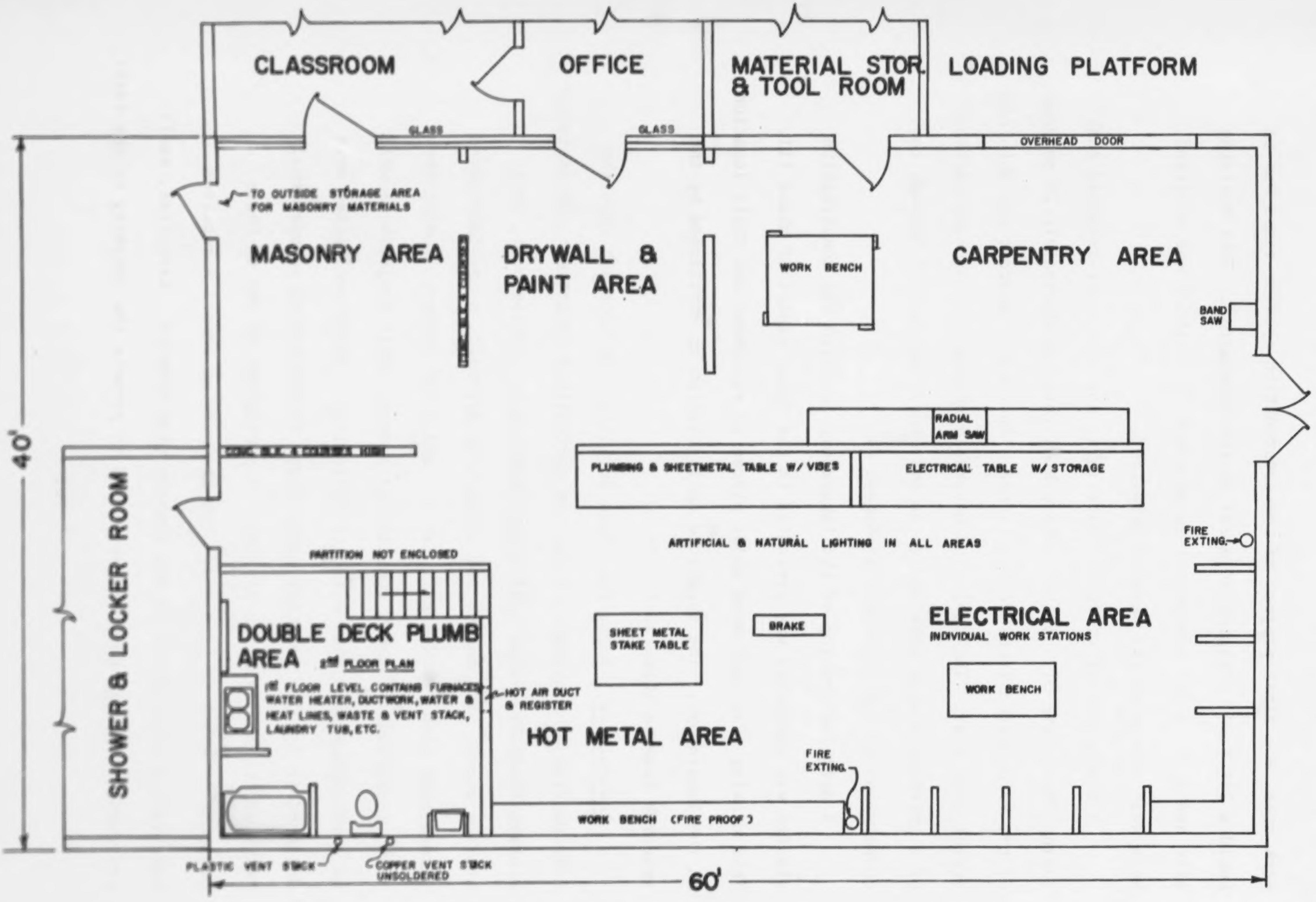


Figure 10. Suggested Floor Plan
Construction Cluster

CONSTRUCTION CLUSTER ACTIVITIES

human requirements and related knowledge. In spite of the limitations placed on the program by the shortage of supplies and materials, the teacher indicated that the learning experiences in all five instructional areas (carpentry, masonry, plumbing, electricity, and painting) were more than adequate for meeting the objectives of this cluster.

In order to evaluate the performance and progress of each student enrolled in the construction cluster, a task inventory was developed by the research team. This inventory included a list of all the tasks to be taught in the cluster. When kept up-to-date, it provided an objective record of student progress and achievement to the teacher, parents, students, and employers. Evaluation by the teacher provided data on how well each student in the class performed the occupational tasks of the construction cluster. The cognitive abilities were measured by the tests. These Achievement Tests are presented in Appendix A. Each student was assigned either a satisfactory (S) or unsatisfactory (U) as an index of his achievement. Those tasks not taught were signified by a blank space on the chart. See Figure 11.

A second instrument for enabling the gathering and reporting of objective data was developed by the research team. This inventory of student abilities and interests was designed primarily to provide guidance counselors and prospective employers a concise and easily understood evaluation of individual students' strengths, abilities, and interests. Included in this instrument were data relevant to interests as reflected by the Minnesota Vocational Interest Inventory and summary ratings on the task performances indicated by superior, average, or below average. Evaluations of student skills and knowledges in the occupational areas of the cluster program were also summarized. A sample of a student's abilities and interests inventory is presented in Appendix B.

Community involvement. Through efforts of Teacher A, in a special way, the community became involved in the implementation of the construction cluster. Local suppliers of building equipment developed an interest in the program and donated materials which were utilized in the area of carpentry, electricity, and plumbing. Community involvement in the cluster program at School A was also evident by the fact that over 85 percent of the class secured summer employment during the summer of 1968, in one of the occupational areas of the construction cluster. Information regarding employment after graduation is presented in the section devoted to this matter.

A visual summary synthesizing evaluations of the five areas (administration, teacher, physical facilities, instruction and community involvement) which have been discussed in the description of the pilot program at School A, is presented in Figure 12.

Figure 11. Task Inventory, School A

CARPENTRY EXPERIENCES

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
[illegible]	1	Mixing mortar for mudsills of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
[illegible]	2	Constructing a saw horse and a trestle for use on construction site.	S	S	S	S	U	S	S	S	S	S	S	S	U	S	S	U	S					
[illegible]	3	Cutting building material to length for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
[illegible]	4	Erecting girders and columns for a house.																						
[illegible]	5	Framing a box sill for a house.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	U	S					
[illegible]	6	Installing hangers and anchors for floor joists for a house.																						
[illegible]	7	Erecting floor and ceiling framing joists for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
[illegible]	8	Installing cross bridging between floor joists for a house.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S					
[illegible]	9	Installing solid bridging between floor joists for a house.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S					
[illegible]	10	Laying subfloors on floor joists for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
[illegible]	11	Framing bathroom floors for a tile floor in a house.																						
[illegible]	12	Building up corner posts for corner of framing in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
[illegible]	13	Laying out stud spacing for walls and partition.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	U	S					
[illegible]	14	Assembling walls and partitions for a frame house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
[illegible]	15	Erecting wall sections for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
[illegible]	16	Building log, plywood or composition [illegible]	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
[illegible]	17	Installing fire stops along plate in a house.																						
[illegible]	18	Installing staging brackets for house construction.																						
[illegible]	19	Installing single and double post scaffolding for house construction.	S	S	S	S	U	S	S	S	S	S	S	S	U	S	S	U	U					
[illegible]	20	Framing a flat roof for a house.			S	S		S				S		S			S							

Figure 11, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	21	Installing gable studs for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	22	Laying roof decking for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	23	Applying building paper to sidewall, rough floor or roof deck on a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	24	Building a foot rest for shingling a roof on a house.																						
II	25	Installing metal drip edge on roof for a house.	S	S	S	S		S	S	S		S	S	S			S							
I	26	Applying roll roofing for a house.	S	S	S	S	S	S	S	S		S	S	S	S	S	S	S	S					
II	27	Applying sheet metal roofing to a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	28	Applying built-up roofing to a house.																						
II	29	Installing a hanging gutter to a house roof.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	30	Fastening wood to masonry with fasteners in a house.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	U	S					
I	31	Installing blanket, bulk, batt, rigid and metallic insulation in a house.	S		S	S		S	S	S	S	S		S			S		S					
I	32	Installing backing to an interior wall of a house.																						
I	33	Applying commercial wall board to the interior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	34	Installing furring and grounds to interior of a house.																						
I	35	Applying lath to house studding.																						
II	36	Applying corner boards on a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	37	Assembling basement stairs for a house.																						
II	38	Erecting roof and deck framing for a house porch.			S	S		S		S				S			S							
II	39	Laying porch floors for a house.			S	S		S									S							
		ELECTRICITY EXPERIENCES																						
I	1	Installing boxes for receptacles, switches, junctions and fixtures in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	2	Installing wiring from box to box in a house.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	U	S					
I	3	Connecting receptacles, single throw switches, fixtures and pilot lights to complete circuits in a house.	S	S	S	S	U	S	S	S	S	S	S	S	U	S	S	U	S					
II	4	Erecting a temporary service pole for portable electric equipment used in building	S	S	S	S	U	S	S	S	S	S	S	S	U	S	S	U	S					

Figure 11, continued

			Student																				
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	5	Installing rigid, thin wall and flexible conduit in a house.				S			S					S										
II	6	Installing a separate circuit for an electric range in a house.																						
II	7	Installing grounds for a house wiring system.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	U	S					
II	8	Installing entrance cable on the exterior of a house.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	U	S					
II	9	Installing low voltage operated bells and signalling devices in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	U	S					
II	10	Connecting a hot water heater to a power source in a house.																						
II	11	Connecting a water pump to a power source in a house.																						
II	12	Installing an attic fan or room cooler in a house.																						
		MASONRY EXPERIENCES																						
I	1	Setting up a work area in order to expedite the mixing of concrete on the job.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	2	Cleaning and oiling concrete forms prior to and after their use on a building.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	3	Preparing a batch of cement, plaster, lime mortar and cement-lime mortar by hand and by machine at the construction site.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	4	Shoring sidewalls of earthen ditches to prevent cave-ins during excavation.																						
II	5	Installing rods and spreaders to space form section before pouring cement.																						
I	6	Wiring and bolting forms to prevent spreading during pouring.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	7	Bracing sidewalls of forms to prevent spreading during pouring.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	8	Installing anchor bolts in masonry walls and concrete to provide a place for securing future construction.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	9	Protecting a concrete slab following finishing operations to provide for proper curing.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	10	Erecting scaffolding for use by a mason at the building site.																						
I	11	Cleaning out mortar joints for tuck pointing on a masonry wall.	S	S	S	S	U	S	U	S	S	S	U	S	S	S	S	U	S					

Figure 11, continued

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	12	Pointing up a section of a brick wall to provide a finished appearance on a house.	S	U	S	S	U	S	S	S	S	S	U	S	U	S	S	U	S					
I	13	Applying colorless coating to waterproof masonry surfaces above grade on a building.																						
I	14	Applying asphalt coating to waterproof foundation wall below grade on a building.																						
I	15	Pouring a section of footing containing reinforcing rods for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	16	Pouring a small reinforced concrete slab suitable for a porch deck on a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	17	Installing footer forms to receive concrete for a foundation.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	18	Setting a section of sidewalk form to receive concrete at a building site.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	19	Finishing a small concrete slab to provide utility and pleasing appearance.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	20	Laying cement block for a wall in stretcher courses for a building.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
		PAINTING EXPERIENCES																						
I	1	Preparing a surface for application of stain on the interior or exterior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	2	Preparing a surface for application of paint on the interior or exterior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	3	Preparing a surface for application of a clear finish on the interior or exterior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	4	Removing old finishes in preparation for resurfacing.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	5	Preparing stain and applicator for use on the interior and exterior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	6	Preparing paint and applicator for use in painting a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	7	Preparing clear finishes and applicators for use on the exterior and interior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	8	Cleaning and storing brushes and rollers following their use in applying finishing materials.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	9	Glazing a window in preparation for painting.						S	S			S			S									
I	10	Preparing joints and nail holes in dry wall construction to receive final finish.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	11	Applying finishing materials to provide protection and decoration of surfaces in or on a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					

Figure 11, continued

PLUMBING EXPERIENCES

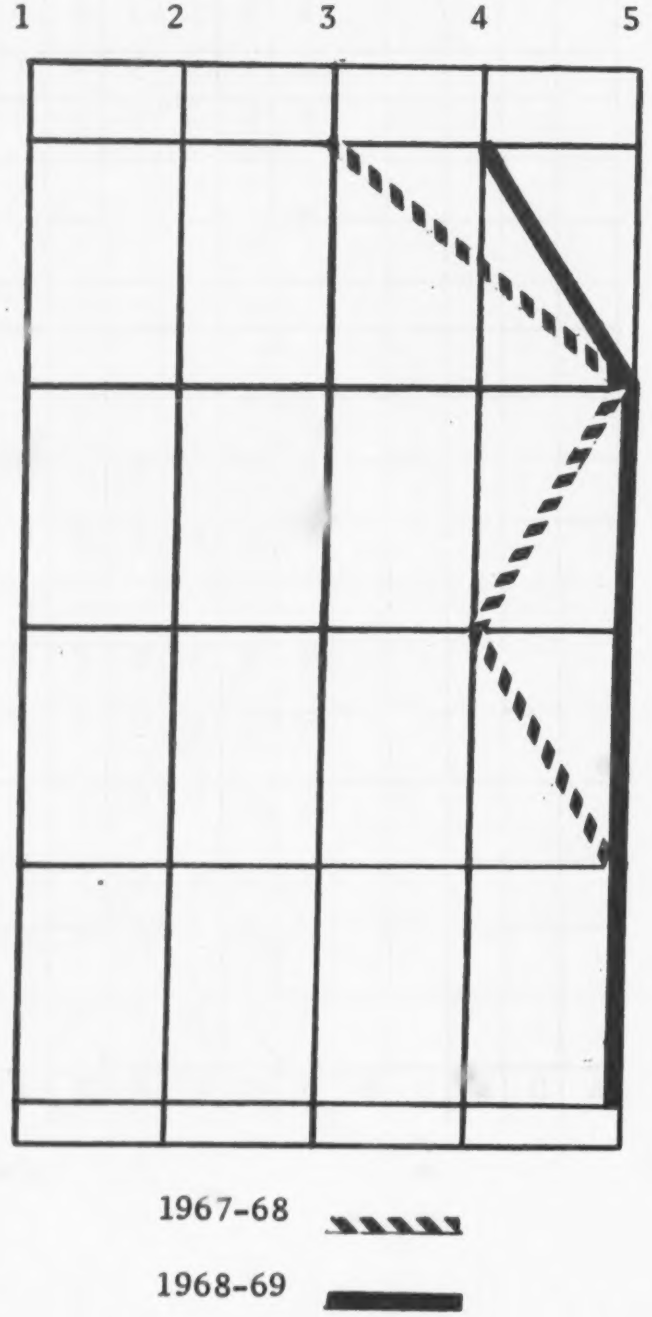
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
			Student																					
I	1	Digging a trench for plumbing installation in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	2	Backfilling a trench following installation of plumbing lines for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	3	Preparing copper tubing for installation in a plumbing system for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	4	Preparing pipe for installation in a plumbing or gas supply system in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	5	Preparing cast iron soil pipe to pour a lead joint for a waste line in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	6	Preparing lead for pouring soil pipe joints for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	7	Laying a drainage field with clay pipe for a house.																						
I	8	Attaching mounting brackets for plumbing fixtures to frame construction.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	U	S					
I	9	Attaching mounting brackets for plumbing fixtures to masonry construction.	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	U	S					
I	10	Installing a water closet seat in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
I	11	Insulating heating and water lines in a house.																						
I	12	Assembling a furnace for a house.																						
I	13	Installing duct work for warm air heating system in a house.																						
II	14	Installing plastic pipe for plumbing lines for a house.																						
II	15	Soldering sheet metal and copper tubing to be used in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	16	Repairing leaks in faucets in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	17	Repairing leaks in a water closet in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S					
II	18	Cleaning waste lines with a snake in a house.																						
I	19	Welding angle iron for pipe hangers.	S		S											S	S							

Figure 12

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL A

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.



Orientation. School C was located in a rural setting and included education from grades 7 through 12. The school program consisted of basic general education for grades 7 and 8. Students entering grade 9 selected a program to be followed for the remainder of their high school career. The students selected either the college entrance, business, or general curriculum.

The introduction of the construction cluster into this school added another dimension to the practical arts curriculum. In addition to the construction cluster the other practical areas of the curriculum included courses in business, home economics, and industrial arts.

The administration. The principal of School C gave his full support to the cluster concept program in his school. Both he and the guidance counselor aided Teacher C with problems involving recruitment of students, scheduling of class time, and procurement of data from school records.

The county administration favored the cluster concept program and provided Teacher C with some of the materials and equipment he needed in order to conduct his program. Very little of this material and equipment was received during the first semester. However, as time elapsed, more of these were progressively received.

The supervisor of industrial education met with members of the research team and with the principal investigator on various occasions to discuss the progress of cluster programs in his county. He was particularly solicitous of the problems encountered by Teacher C in operating his pilot program.

The teacher. Teacher C held a B.S. degree in Agriculture with a major in Horticulture. He had several years experience with a producer's cooperative, followed by four and one-half years military service as an ordnance instructor of automotives, as well as tank electrical systems. Following World War II he enrolled in graduate school in order to obtain certification to teach vocational agriculture. Teacher C has had two and one-half years experience teaching agriculture and fifteen years experience as an industrial arts instructor.

Physical facilities. The class met in the industrial arts laboratory and utilized the equipment in this facility. This laboratory was large enough to accommodate a class of this size, but to accommodate industrial arts classes and the cluster program strained the space allotments.

At the start of the 1967-1968 school year, none of the materials and equipment specified for the cluster concept program was on hand. Teacher C met with severe restrictions but was able to carry the program through the first semester with the limited tools and materials used in his regular industrial arts program. During the course of the school year, approximately 35 percent of the recommended tools, equipment, and materials were received. During the 1968-1969 school year, an additional 40 percent of the recommended tools, equipment, and materials were received.

A detailed drawing of the laboratory in which the construction cluster was conducted was presented in the final report of phase III. This drawing also indicated major pieces of equipment and their location in the laboratory. The recommended facilities for such a program was presented in Figure 10.

Instruction. The original fourteen students enrolled in the cluster concept program at School C included several seniors. As a result, only five students completed the two-year pilot program, whereas the seniors completed one year. During the school year individual students constructed several small projects, items for use in the laboratory, or repaired various pieces of school equipment. These activities were designed to develop certain tool skills necessary for the successful completion of the occupational tasks in the construction cluster.

Among the group learning experiences at School C was the construction of a concrete slab area to facilitate the completion of the masonry tasks, wiring and installing electrical outlets for the laboratory, bending and installing conduit and electrical boxes, tool holder rack for the wood lathe, renovation of the lumber and materials storage area, installing book shelving in the school library, constructing a metal rack for storing choir robes, laying brick and concrete blocks, building saw horses, and preparing the finishing room for use in the industrial arts classes. In some instances, these jobs required the practice of elemental tasks;when this occurred they were interjected prior to completing a project.

In order to evaluate the performance and progress of each student enrolled in the construction cluster, a task inventory was developed by the research team. This inventory included a list of all the tasks to be taught in the cluster. When kept up-to-date, it provided an objective record of student progress and achievement to the teacher, parents, students, and employers. Evaluation by the teacher provided data on how well each student in the class performed the occupational tasks of the construction cluster. The cognitive abilities were measured by the tests. These are provided in Appendix A. Each student was assigned either a satisfactory (S) or unsatisfactory (U) as an index of his achievement. Those tasks not taught were signified by a blank space on the chart. See Figure 13.

A second instrument for enabling the gathering and reporting objective data was developed by the research team. This inventory of student abilities and interests was designed primarily to provide guidance counselors and prospective employers a concise and easily understood evaluation of individual students' strengths, abilities, and interests. Included in this instrument were data relevant to interests as reflected by the Minnesota Vocational Interest Inventory, and summary ratings on the task performances indicated by superior, average, or below average. Evaluations of student skills and knowledges in the occupational areas of the cluster program were also summarized. A sample student abilities and interests inventory is presented in Appendix B.

Community involvement. Community involvement in the construction cluster at School C was to some extent limited. Teacher C was able to obtain a quantity of used brick to be used for masonry exercises from a local construction company.

The building of an addition to School C provided the class many opportunities to view various activities involved in commercial construction, while not having to leave school property.

A visual summary synthesizing evaluation of the five areas (administration, teacher, physical facilities, instruction, and community involvement) which have been discussed in the description of the pilot program at School C, is presented in Figure 14.

Figure 13. Task Inventory, School C

CARPENTRY EXPERIENCES

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Mixing mortar for mudsills of a house.	S	S	S	S	S	S																
I	2	Constructing a saw horse and a trestle for use on construction site.	S	S	S	S	S	S																
II	3	Cutting building material to length for a house.	S	S	S	S	S	S																
I	4	Erecting girders and columns for a house.	S	S	S	S	S	S																
II	5	Framing a box sill for a house.	S	S	S	S	S	S																
I	6	Installing hangers and anchors for floor joists for a house.	S	S	S	S	S	S																
II	7	Erecting floor and ceiling framing joists for a house.	S	S	S	S	S	S																
I	8	Installing cross bridging between floor joists for a house.	S	S	S	S	S	S																
I	9	Installing solid bridging between floor joists for a house.	S	S	S	S	S	S																
I	10	Laying subfloors on floor joists for a house.	S	S	S	S	S	S																
II	11	Framing bathroom floors for a tile floor in a house.																						
II	12	Building up corner posts for corner of framing in a house.	S	S	S	S	S	S																
II	13	Laying out stud spacing for walls and partition.	S	S	S	S	S	S																
II	14	Assembling walls and partitions for a frame house.	S	S	S	S	S	S																
II	15	Erecting wall sections for a house.	S	S	S	S	S	S																
I	16	Applying lap, plywood or composition sheathing for a house.	S	S	S	S	S	S																
I	17	Installing fire stops along plate in a house.	S	S	S	S	S	S																
II	18	Installing staging brackets for house construction.																						
II	19	Installing single and double post scaffolding for house construction.																						
II	20	Framing a flat roof for a house.																						

Figure 13, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	21	Installing gable studs for a house.	S	S	S	S	S	S																
I	22	Laying roof decking for a house.	S	S	S	S	S	S																
I	23	Applying building paper to sidewall, rough floor or roof deck on a house.	S	S	S	S	S	S																
I	24	Building a foot rest for shingling a roof on a house.																						
II	25	Installing metal drip edge on roof for a house.	S	S	S	S	S	S																
I	26	Applying roll roofing for a house.	S	S	S	S	S	S																
II	27	Applying sheet metal roofing to a house.																						
II	28	Applying built-up roofing to a house.																						
II	29	Installing a hanging gutter to a house roof.																						
II	30	Fastening wood to masonry with fasteners in a house.	S	S	S	S	S	S																
I	31	Installing blanket, bulk, batt, rigid and metallic insulation in a house.	S	S	S	S	S	S																
I	32	Installing backing to an interior wall of a house.																						
I	33	Applying commercial wall board to the interior of a house.																						
II	34	Installing furring and grounds to interior of a house.																						
I	35	Applying lath to house studding.																						
II	36	Applying corner boards on a house.	S	S	S	S	S	S																
II	37	Assembling basement stairs for a house.																						
II	38	Erecting roof and deck framing for a house porch.																						
II	39	Laying porch floors for a house.																						
		ELECTRICITY EXPERIENCES																						
I	1	Installing boxes for receptacles, switches, junctions and fixtures in a house.	S	S	S	S	S	S																
I	2	Installing wiring from box to box in a house.	S	S	S	S	S	S																
I	3	Connecting receptacles, single throw switches, fixtures and pilot lights to complete circuits in a house.	S	S	S	S	S	S																
II	4	Erecting a temporary service pole for portable electric equipment used in building.																						

Figure 13, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	5	Installing rigid, thin wall and flexible conduit in a house.	S	S	S	S	S	S																
II	6	Installing a separate circuit for an electric range in a house.																						
II	7	Installing grounds for a house wiring system.	S	S	S	S	S	S																
II	8	Installing entrance cable on the exterior of a house.																						
II	9	Installing low voltage operated bells and signalling devices in a house.	S	S	S	S	S	S																
II	10	Connecting a hot water heater to a power source in a house.																						
II	11	Connecting a water pump to a power source in a house.																						
II	12	Installing an attic fan or room cooler in a house.																						
		MASONRY EXPERIENCES																						
I	1	Setting up a work area in order to expedite the mixing of concrete on the job.	S	S	S	S	S	S																
I	2	Cleaning and oiling concrete forms prior to and afer their use on a building.	S	S	S	S	S	S																
II	3	Preparing a batch of cement, plaster, lime mortar and cement-lime mortar by hand and by machine at the construction site.	S	S	S	S	S	S																
I	4	Shoring sidewalls of earthen ditches to prevent cave-ins during excavation.																						
II	5	Installing rods and spreaders to space form section before pouring cement.																						
I	6	Wiring and bolting forms to prevent spreading during pouring.																						
II	7	Bracing sidewalls of forms to prevent spreading during pouring.																						
I	8	Installing anchor bolts in masonry walls and concrete to provide a place for securing future construction.	S	S	S	S	S	S																
I	9	Protecting a concrete slab following finishing operations to provide for proper curing.																						
I	10	Erecting scaffolding for use by a mason at the building site.																						
I	11	Cleaning out mortar joints for tuck pointing on a masonry wall.																						

Figure 13, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	12	Pointing up a section of a brick wall to provide a finished appearance on a house.	S	S	S	S	S	S																
I	13	Applying colorless coating to waterproof masonry surfaces above grade on a building.																						
I	14	Applying asphalt coating to waterproof foundation wall below grade on a building.																						
I	15	Pouring a section of footing containing reinforcing rods for a house.																						
I	16	Pouring a small reinforced concrete slab suitable for a porch deck on a house.																						
II	17	Installing footer forms to receive concrete for a foundation.																						
II	18	Setting a section of sidewalk form to receive concrete at a building site.																						
II	19	Finishing a small concrete slab to provide utility and pleasing appearance.																						
II	20	Laying cement block for a wall in stretcher courses for a building.	S	S	S	S	S	S																
		PAINTING EXPERIENCES																						
I	1	Preparing a surface for application of stain on the interior or exterior of a house.	S	S	S	S	S	S																
I	2	Preparing a surface for application of paint on the interior or exterior of a house.																						
II	3	Preparing a surface for application of a clear finish on the interior or exterior of a house.	S	S	S	S	S	S																
I	4	Removing old finishes in preparation for resurfacing.																						
I	5	Preparing stain and applicator for use on the interior and exterior of a house.	S	S	S	S	S	S																
II	6	Preparing paint and applicator for use in painting a house.	S	S	S	S	S	S																
I	7	Preparing clear finishes and applicators for use on the exterior and interior of a house.																						
I	8	Cleaning and storing brushes and rollers following their use in applying finishing materials.	S	S	S	S	S	S																
I	9	Glazing a window in preparation for painting.	S	S	S	S	S	S																
I	10	Preparing joints and nail holes in dry wall construction to receive final finish.																						
I	11	Applying finishing materials to provide protection and decoration of surfaces in or on a house.																						

Figure 13, continued

PLUMBING EXPERIENCES

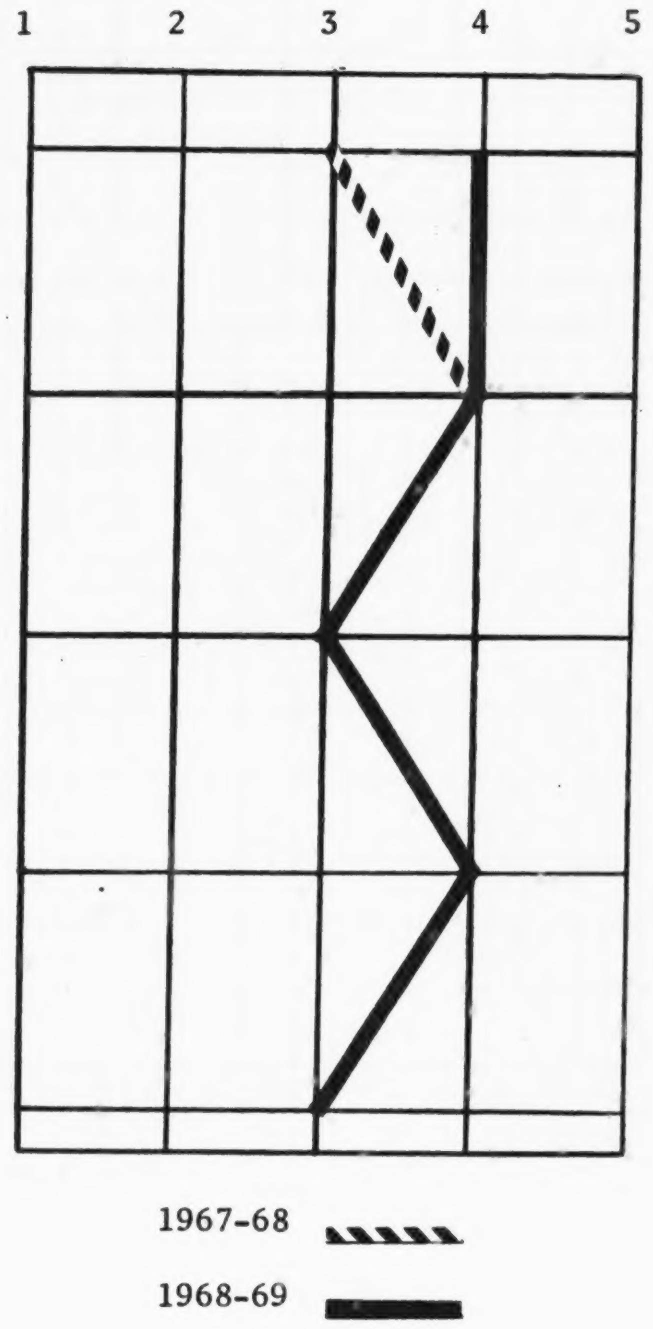
			Student																			
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Digging a trench for plumbing installation in a house.																						
I	2	Backfilling a trench following installation of plumbing lines for a house.																						
I	3	Preparing copper tubing for installation in a plumbing system for a house.	S	S	S	S	S	S																
I	4	Preparing pipe for installation in a plumbing or gas supply system in a house.	S	S	S	S	S	S																
I	5	Preparing cast iron soil pipe to pour a lead joint for a waste line in a house.	S	S	S	S	S	S																
I	6	Preparing lead for pouring soil pipe joints for a house.	S	S	S	S	S	S																
I	7	Laying a drainage field with clay pipe for a house.																						
I	8	Attaching mounting brackets for plumbing fixtures to frame construction.																						
I	9	Attaching mounting brackets for plumbing fixtures to masonry construction.																						
I	10	Installing a water closet seat in a house.	S	S	S	S	S	S																
I	11	Insulating heating and water lines in a house.	S	S	S	S	S	S																
I	12	Assembling a furnace for a house.																						
I	13	Installing duct work for warm air heating system in a house.																						
II	14	Installing plastic pipe for plumbing lines for a house.	S	S	S	S	S	S																
II	15	Soldering sheet metal and copper tubing to be used in a house.	S	S	S	S	S	S																
II	16	Repairing leaks in faucets in a house.																						
II	17	Repairing leaks in a water closet in a house.																						
II	18	Cleaning waste lines with a snake in a house.	S	S	S	S	S	S																
I	19	Welding angle iron for pipe hangers.																						

Figure 14

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL C

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.



Orientation. School D was characterized as a comprehensive high school composed of grades 10 through 12, located in an urban community. The school program consisted of college entrance, business, general, and vocational curricula. Students entering grade 10 selected one of these programs to be followed for the remainder of their high school career.

In addition to the areas of home economics and business, the other vocational programs in School D included automotives, painting and interior decorating, carpentry, metalworking, masonry, graphic arts, and cosmetology. School D also had several industrial arts courses.

The introduction of the construction cluster into this school enabled those students enrolled in the general program to elect a course which would provide them with technical skills, while not tracking them into the one-occupation type vocational program.

The administration. The school administration favored the cluster concept program and aided Teacher D with problems involving enrollment and class time.

Due to a very tight schedule and a tremendous work load, the supervisor was able to meet only once with the members of the research team and the principal investigator during the year to discuss the cluster concept programs in his county.

The thrust of support from this supervisor came in terms of providing the necessary tools, equipment, and materials for implementing the construction cluster at School D. These provisions were more than adequate.

The teacher. Teacher D's education consisted of a B.S. degree in Trade Education, plus six graduate credits in vocational education.

Teacher D had seventeen years teaching experience at the senior high school level. He also had experience in teaching adult education courses, and had several years experience in the construction field both full and part-time as a bricklayer. During World War II he had served on the cadre at a basic training center.

Physical facilities. The class met in the laboratory used for instruction in vocational masonry. While the facility was large enough to accommodate the class, it did not contain enough work space needed in order to instruct the students in the four other areas of the construction cluster.

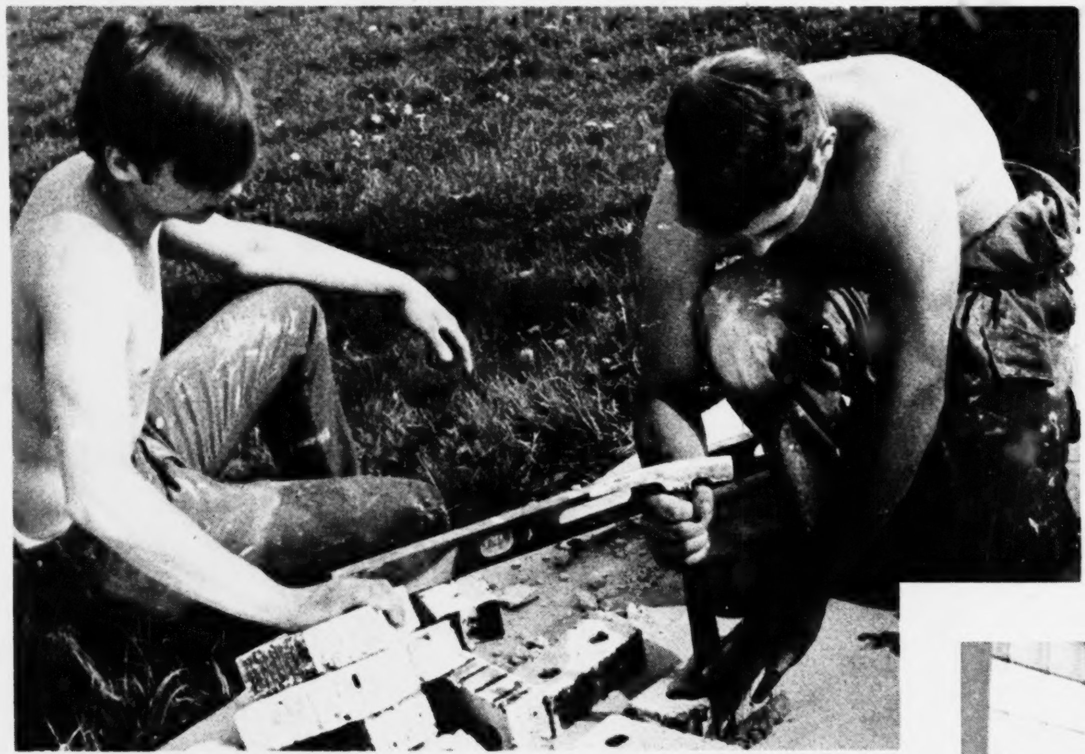
Because of the physical limitations of the laboratory, Teacher D utilized the other vocational laboratories in the school such as the carpentry laboratory and the facilities used for painting and interior decorating.

A detailed drawing of the laboratory in which the construction cluster was conducted was presented in the final report of phase III. This drawing also indicated major pieces of equipment and depicted their location in the laboratory. The recommended laboratory layout was presented in Figure 10.

At the start of the 1967-1968 school year, Teacher D had 50 percent of the tools and equipment recommended by the cluster concept research team as necessary to conduct an efficient program. During the course of that school year, approximately 25 percent more of the recommended materials and equipment were obtained. During the 1968-1969 school year an additional 15 percent was received.

Instruction. At the beginning of the two year pilot program at School D, sixteen students were enrolled; of that number only seven completed the program. Varied reasons for the loss of subjects

CONSTRUCTION CLUSTER ACTIVITIES



beyond the control of the research staff were encountered. The construction cluster class utilized other vocational laboratories within the school when performing the various tasks in the occupational areas of carpentry, electricity, masonry, painting, and plumbing. The tasks in these areas were accomplished by constructing a corner section of a building thus performing the various tasks structured in the program.

Most of the instruction in the construction cluster at School D centered around the masonry tasks. A second corner section was constructed to provide learning experiences in dry wall construction, brick veneering, laying sub flooring, and installing windows and doors. This corner section was also designed to provide for instruction in plumbing and electrical wiring. However, very little instruction was provided in these areas of the construction cluster. Although the materials were provided by the county supervisor, the plans to build an outside structure never materialized, curtailing the completion of all the tasks required in the construction cluster.

In order to evaluate the performance and progress of each student enrolled in the construction cluster, a task inventory was developed by the research team. This inventory included a list of all the tasks to be taught in the cluster. When kept up-to-date, it provided an objective record of student progress and achievement to the teacher, parents, students, and employers. Evaluation by the teacher provided data on how well each student in the class performed the occupational tasks of the construction cluster. The cognitive abilities were measured by the tests. These are provided in Appendix A. Each studnet was assigned either a satisfactory (S) or unsatisfactory (U) as an index of his achievement. Those tasks not taught were signified by a blank space on the chart. See Figure 15.

Figure 15

TASK INVENTORY, SCHOOL D, TEACHER D

CARPENTRY EXPERIENCES

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Mixing mortar for mudsills of a house.	S	S	S	S	S	S	S	S	S	S	S											
I	2	Constructing a saw horse and a trestle for use on construction site.	S	S	S	S	S	S	S	S	S	S	S											
II	3	Cutting building material to length for a house.	S	S	S	S	U																	
I	4	Erecting girders and columns for a house.	U	S	S	S	S	S	S	U	S	S	S											
II	5	Framing a box sill for a house.	S	S	S	S	U																	
I	6	Installing hangers and anchors for floor joists for a house.	S	S	S	S	S	S	S	S	S	S	S											
II	7	Erecting floor and ceiling framing joists for a house.	S	S	S	S	U																	
I	8	Installing cross bridging between floor joists for a house.	S	S	S	S	U	S	S	S	S	S	S											
I	9	Installing solid bridging between floor joists for a house.	S	S	S	S		S	S	S	S	S	S											
I	10	Laying subfloors on floor joists for a house.	S	S	S	S		S	S	S	S	S	S											
II	11	Framing bathroom floors for a tile floor in a house.	U	U	S	S	S																	
II	12	Building up corner posts for corner of framing in a house.	S	S	S	S																		
II	13	Laying out stud spacing for walls and partition.	S	S	S	S																		
II	14	Assembling walls and partitions for a frame house.	S	S	S	S	S																	
II	15	Erecting wall sections for a house.	U	S	S	S																		
I	16	Applying lap, plywood or composition sheathing for a house.	S	S	S	S		S	S	U	S	S	S											
I	17	Installing fire stops along plate in a house.	S	S	S	S	S	S	S	S	S	S	S											
II	18	Installing staging brackets for house construction.	S	S	S	S																		
II	19	Installing single and double post scaffolding for house construction.	S	S	S	S	S																	
II	20	Framing a flat roof for a house.	S	S	S	S																		

Figure 15, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	21	Installing gable studs for a house.																						
I	22	Laying roof decking for a house.	S	S	S	S	U	S	S	S	S	S	S											
I	23	Applying building paper to sidewall, rough floor or roof deck on a house.	S	S	S	S	U	S	S	S	S	S	S											
I	24	Building a foot rest for shingling a roof on a house.	U	U	U	S	U	S	S	S	S	S	S											
II	25	Installing metal drip edge on roof for a house.	S	S	S	S	S																	
I	26	Applying roll roofing for a house.	S	S	S	S	S	S	S	U	S	S	S											
II	27	Applying sheet metal roofing to a house.	U	S	S	S	U		U															
II	28	Applying built-up roofing to a house.																						
II	29	Installing a hanging gutter to a house roof.	S	S	S	S	U																	
II	30	Fastening wood to masonry with fasteners in a house.	S	S	S	S	S																	
I	31	Installing blanket, bulk, batt, rigid and metallic insulation in a house.	S	S	S	S	U	S	S	U	S	S	S											
I	32	Installing backing to an interior wall of a house.	S	S	S	S	U	S	S	S	S	S	S											
I	33	Applying commercial wall board to the interior of a house.	S	S	S	S	S	S	S	S	S	S	S											
II	34	Installing furring and grounds to interior of a house.	S	S	S	S	U																	
I	35	Applying lath to house studding.	S	S	S	S	U	S	S	S	S	S	S											
II	36	Applying corner boards on a house.	S	S	S	S	U																	
II	37	Assembling basement stairs for a house.																						
II	38	Erecting roof and deck framing for a house porch.	S	S	S	S	S																	
II	39	Laying porch floors for a house.	S	S	S	S	U																	
		ELECTRICITY EXPERIENCES																						
I	1	Installing boxes for receptacles, switches, junctions and fixtures in a house.	S	S	S	S	U	S	S	U	S	S	S											
I	2	Installing wiring from box to box in a house.	S	S	S	S	U	S	S	S	S	S	S											
I	3	Connecting receptacles, single throw switches, fixtures and pilot lights to complete circuits in a house.																						
II	4	Erecting a temporary service pole for portable electric equipment used in building.																						

Figure 15, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	5	Installing rigid, thin wall and flexible conduit in a house.																						
II	6	Installing a separate circuit for an electric range in a house.																						
II	7	Installing grounds for a house wiring system.																						
II	8	Installing entrance cable on the exterior of a house.																						
II	9	Installing low voltage operated bells and signalling devices in a house.																						
II	10	Connecting a hot water heater to a power source in a house.																						
II	11	Connecting a water pump to a power source in a house.	S	S	S	S	S																	
II	12	Installing an attic fan or room cooler in a house.	S	S	S	S	S																	
		MASONRY EXPERIENCES																						
I	1	Setting up a work area in order to expedite the mixing of concrete on the job.	S	S	S	S	S	S	S	S	S	S	S											
I	2	Cleaning and oiling concrete forms prior to and afer their use on a building.	S	S	S	S	S	S	S	S	S	S	S											
II	3	Preparing a batch of cement, plaster, lime mortar and cement-lime mortar by hand and by machine at the construction site.	S	S	S	S	S	S	S	S	S	S	S											
I	4	Shoring sidewalls of earthen ditches to prevent cave-ins during excavation.	S	S	S	S	S	S	S	S	S	S	S											
II	5	Installing rods and spreaders to space form section before pouring cement.	S	S	S	S	S	S	S	S	S	S	S											
I	6	Wiring and bolting forms to prevent spreading during pouring.	S	S	S	S	S	S	S	S	S	S	S											
II	7	Bracing sidewalls of forms to prevent spreading during pouring.	S	S	S	S	S	S	S	S	S	S	S											
I	8	Installing anchor bolts in masonry walls and concrete to provide a place for securing future construction.	S	S	S	S	S	S	S	S	S	S	S											
I	9	Protecting a concrete slab following finishing operations to provide for proper curing.	S	S	S	S	S	S	S	S	S	S	S											
I	10	Erecting scaffolding for use by a mason at the building site.	S	S	S	S	S	S	S	S	S	S	S											
I	11	Cleaning out mortar joints for tuck pointing on a masonry wall.	S	S	S	S	S	S	S	S	S	S	S											

Figure 15, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	12	Pointing up a section of a brick wall to provide a finished appearance on a house.	S	S	S	S	U	S	S	S	S	S	S											
I	13	Applying colorless coating to waterproof masonry surfaces above grade on a building.	S	S	S	S	U	S	S	S	S	S	S											
I	14	Applying asphalt coating to waterproof foundation wall below grade on a building.	S	S	S	S	U	S	S	S	S	S	S											
I	15	Pouring a section of footing containing reinforcing rods for a house.	S	S	S	S	U	S	S	S	S	S	S											
I	16	Pouring a small reinforced concrete slab suitable for a porch deck on a house.	S	S	S	S	U	S	S	S	S	S	S											
II	17	Installing footer forms to receive concrete for a foundation.	S	S	S	S	U	S	S	S	S	S	S											
II	18	Setting a section of sidewalk form to receive concrete at a building site.	S	S	S	S	U	S	S	S	S	S	S											
II	19	Finishing a small concrete slab to provide utility and pleasing appearance.	S	S	S	S	U	S	S	S	S	S	S											
II	20	Laying cement block for a wall in stretcher courses for a building.	S	S	S	S	S	S	S	S	S	S	S											
		PAINTING EXPERIENCES																						
I	1	Preparing a surface for application of stain on the interior or exterior of a house.	S	S	S	S	S	S	S	S	S	S	S											
I	2	Preparing a surface for application of paint on the interior or exterior of a house.	S	S	S	S	S	S	S	S	S	S	S											
II	3	Preparing a surface for application of a clear finish on the interior or exterior of a house.	U	S	S	S	S	S	S	S	S	S	S											
I	4	Removing old finishes in preparation for resurfacing.	S	S	S	S	S	S	S	S	S	S	S											
I	5	Preparing stain and applicator for use on the interior and exterior of a house.	S	S	S	S	S	S	S	S	S	S	S											
II	6	Preparing paint and applicator for use in painting a house.	S	S	S	S	S	S	S	S	S	S	S											
I	7	Preparing clear finishes and applicators for use on the exterior and interior of a house.	S	S	S	S	S	S	S	S	S	S	S											
I	8	Cleaning and storing brushes and rollers following their use in applying finishing materials.	S	S	S	S	S	S	S	S	S	S	S											
I	9	Glazing a window in preparation for painting.	S	S	S	S	S	S	S	S	S	S	S											
I	10	Preparing joints and nail holes in dry wall construction to receive final finish.	S	S	S	S	S	S	S	S	S	S	S											
I	11	Applying finishing materials to provide protection and decoration of surfaces in or on a house.	S	S	S	S	S	S	S	S	S	S	S											

Figure 15, continued

PLUMBING EXPERIENCES

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Digging a trench for plumbing installation in a house.	S	S	S	S	U	S	S	S	S	S	S											
I	2	Backfilling a trench following installation of plumbing lines for a house.	S	S	S	S	U	S	S	S	S	S	S											
I	3	Preparing copper tubing for installation in a plumbing system for a house.	S	S	S	S	U	S	S	S	S	S	S											
I	4	Preparing pipe for installation in a plumbing or gas supply system in a house.																						
I	5	Preparing cast iron soil pipe to pour a lead joint for a waste line in a house.																						
I	6	Preparing lead for pouring soil pipe joints for a house.	S	S	S	S	U	S	S	S	S	S	S											
I	7	Laying a drainage field with clay pipe for a house.	S	S	S	S	U	S	S	S	S	S	S											
I	8	Attaching mounting brackets for plumbing fixtures to frame construction.	S	S	S	S	U	S	S	S	S	S	S											
I	9	Attaching mounting brackets for plumbing fixtures to masonry construction.																						
I	10	Installing a water closet seat in a house.																						
I	11	Insulating heating and water lines in a house.	S	S	S	S		S	S															
I	12	Assembling a furnace for a house.																						
I	13	Installing duct work for warm air heating system in a house.																						
II	14	Installing plastic pipe for plumbing lines for a house.																						
II	15	Soldering sheet metal and copper tubing to be used in a house.	S	S	S	S	S																	
II	16	Repairing leaks in faucets in a house.	S	S	S	S	U																	
II	17	Repairing leaks in a water closet in a house.																						
II	18	Cleaning waste lines with a snake in a house.																						
I	19	Welding angle iron for pipe hangers.																						

A second instrument for enabling the gathering and reporting of objective data was developed by the research team. This inventory of student abilities and interests was designed primarily to provide guidance counselors and prospective employers a concise and easily understood evaluation of individual students' strengths, abilities, and interests. Included in this instrument were data relevant to interests as reflected by the Minnesota Vocational Interest Inventory, and summary ratings on the task performances indicated by superior, average, or below average. Evaluations of student skills and knowledges in the occupational areas of the cluster program were also summarized. A sample student abilities and interests inventory is presented in Appendix B.

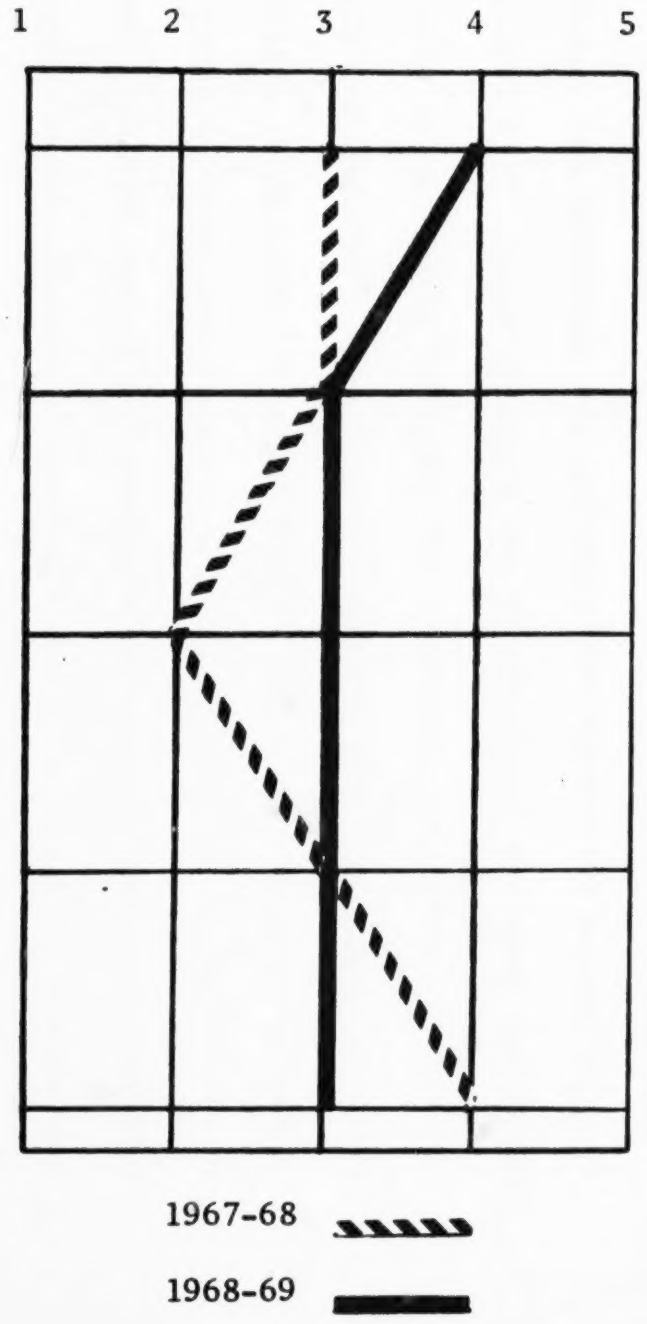
Community involvement. Community involvement in the construction cluster at School D was limited to field trips and tours of local construction sites. During the 1967-1968 school year, several members of the class were able to secure employment in one of the occupational areas of the cluster within the community.

A visual summary synthesizing evaluations of the five areas (administration, teacher, physical facilities, instruction and community involvement) which have been discussed in the description of the construction cluster pilot program at School D, is presented in Figure XVI.

Figure 16.

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM
SCHOOL D - TEACHER D

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.



Orientation. School H was located in a rural community and was organized to include grades 7 through 12. The school program consisted of basic general education for grades 7 and 8. Students entering grade 9 selected a program to be followed for the remainder of their high school career. The students selected either the college entrance, business, or general curriculum.

The introduction of the construction cluster into this school added another dimension to the practical arts curriculum. In addition to the construction cluster, the other practical areas of the curriculum included courses in vocational agriculture, business, home economics, and industrial arts.

The administration. The principal of School H supported the cluster concept program and gave his full cooperation to Teacher H in his execution of the program.

The county administration, while favoring the program, provided Teacher H with little additional equipment or supplies to conduct his class. In discussing the lack of material and supplies with county officials and Teacher H, members of the research team were unable to determine the source of the problem. Either the county had not processed the requisitions submitted, or Teacher H never submitted requisitions for additional equipment, material, or supplies.

The teacher. Teacher H earned a B.S. degree in Physical Education with a minor in Social Studies. He also had a M.A. degree in School Administration with a minor in Geography. Teacher H had six years teaching experience in industrial arts and four years industrial experience in home construction.

Physical facilities. The construction cluster class met in the industrial arts laboratory and utilized the equipment in this facility. Whenever the weather allowed, members of the construction cluster also utilized a paved area adjacent to the laboratory for the construction of a tool shed and other projects of this type.

At the start of the 1967-1968 school year, approximately 15 percent of the equipment and materials recommended by the cluster concept project research team as necessary to conduct an effective program had been received. Later that school year an additional 10 percent of the recommended materials were received. During the 1968-1969 school year, another 25 percent of the recommended materials was obtained.

Teacher H conducted his program by utilizing the material and equipment allocated for his regular industrial arts program. Teacher H also obtained orders from private individuals for the construction of tool or garden sheds. These items were constructed by members of the construction cluster and sold for the cost of the materials in order to secure additional materials needed for the cluster concept program.

A detailed drawing of the laboratory in which the construction cluster was conducted was included in the final report of phase III. The drawing also indicated the major pieces of equipment and illustrated their location in the laboratory. The recommended specifications for such a laboratory are presented in Illustration 10.

Instruction. Thirteen of the sixteen students who enrolled in the construction cluster class at School H in September of 1967 completed this two-year pilot program in June of 1969.

Carpentry and painting were the only occupational areas of the construction cluster taught at School H. These learning experiences were centered on the designing, construction, and painting of several Swissstyle shed and storage structures. Some of these structures utilized the pre-fabricated technique of construction with final assembly taking place at the permanent location. This instruction was supplemented with field trips to building supply dealers and to the construction sites of several housing developments.

In order to evaluate the performance and progress of each student enrolled in the construction cluster, a task inventory was developed by the research team. This inventory included a list of all the tasks to be taught in the cluster. When kept up-to-date, it provided an objective record of student progress and achievement to the teacher, parents, students, and employers. Evaluation by the teacher provided data on how well each student in the class performed the occupational tasks of the construction cluster. The cognitive abilities were measured by the tests. These are provided in Appendix A. Each student was assigned either a satisfactory (S) or unsatisfactory (U) as an index of his achievement. Those tasks not taught were signified by a blank space on the chart. See Figure 17.

A second instrument for enabling the gathering and reporting of objective data was developed by the research team. This inventory of student abilities and interests was designed primarily to provide guidance counselors and prospective employers a concise and easily understood evaluation of individual students' strengths, abilities, and interests. Included in this instrument were data relevant to interests as reflected by the Minnesota Vocational Interest Inventory, and summary ratings on the task performances indicated by superior, average, or below average. Evaluations of student skills and knowledges in the occupational areas of the cluster program were also summarized. A sample of the form used to summarize student abilities and interest inventory is presented in Appendix B.

Figure 17.

TASK INVENTORY, SCHOOL H

CARPENTRY EXPERIENCES

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Mixing mortar for mudsills of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	2	Constructing a saw horse and a trestle for use on construction site.	S	S	S	S	S	S	S	S	S	S	S	S	S									
II	3	Cutting building material to length for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	4	Erecting girders and columns for a house.																						
II	5	Framing a box sill for a house.																						
I	6	Installing hangers and anchors for floor joists for a house.																						
II	7	Erecting floor and ceiling framing joists for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	8	Installing cross bridging between floor joists for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	9	Installing solid bridging between floor joists for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	10	Laying subfloors on floor joists for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
II	11	Framing bathroom floors for a tile floor in a house.																						
II	12	Building up corner posts for corner of framing in a house.	S	S	S	U	S	S	S	S	S	S	S	S	U									
II	13	Laying out stud spacing for walls and partition.	S	S	S	U	S	S	S	S	S	S	S	S	U									
II	14	Assembling walls and partitions for a frame house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
II	15	Erecting wall sections for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	16	Applying lap, plywood or composition sheathing for a house.	S	S	S	U	S	S	S	S	S	S	S	S	U									
I	17	Installing fire stops along plate in a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
II	18	Installing staging brackets for house construction.																						
II	19	Installing single and double post scaffolding for house construction.	S	S	S	S	S	S	S	S	S	S	S	S	S									
II	20	Framing a flat roof for a house.	S	S	S	U	S	S	S	S	S	S	S	S	U									

Figure 17, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
			Student																					
II	21	Installing gable studs for a house.																						
I	22	Laying roof decking for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	23	Applying building paper to sidewall, rough floor or roof deck on a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	24	Building a foot rest for shingling a roof on a house.																						
II	25	Installing metal drip edge on roof for a house.																						
I	26	Applying roll roofing for a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
II	27	Applying sheet metal roofing to a house.																						
II	28	Applying built-up roofing to a house.																						
II	29	Installing a hanging gutter to a house roof.																						
II	30	Fastening wood to masonry with fasteners in a house.																						
I	31	Installing blanket, bulk, batt, rigid and metallic insulation in a house.																						
I	32	Installing backing to an interior wall of a house.																						
I	33	Applying commercial wall board to the interior of a house.																						
II	34	Installing furring and grounds to interior of a house.																						
I	35	Applying lath to house studding.																						
II	36	Applying corner boards on a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
II	37	Assembling basement stairs for a house.	S	S	S	U	S	S	S	S	S	S	S	S	U									
II	38	Erecting roof and deck framing for a house porch.	S	S	S	U	S	S	S	S	S	S	S	S	U									
II	39	Laying porch floors for a house.																						
		ELECTRICITY EXPERIENCES																						
I	1	Installing boxes for receptacles, switches, junctions and fixtures in a house.	S	U	S	U	S	S	S	U	U	S	S	S	U									
I	2	Installing wiring from box to box in a house.	U	U	S	U	S	S	S	U	S	S	S	S	U									
I	3	Connecting receptacles, single throw switches, fixtures and pilot lights to complete circuits in a house.	U	U	S	U	S	U	S	S	U	S	U	S	U									
II	4	Erecting a temporary service pole for portable electric equipment used in building.																						

Figure 17, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	5	Installing rigid, thin wall and flexible conduit in a house.																						
II	6	Installing a separate circuit for an electric range in a house.																						
II	7	Installing grounds for a house wiring system.																						
II	8	Installing entrance cable on the exterior of a house.																						
II	9	Installing low voltage operated bells and signalling devices in a house.																						
II	10	Connecting a hot water heater to a power source in a house.																						
II	11	Connecting a water pump to a power source in a house.																						
II	12	Installing an attic fan or room cooler in a house.																						
		MASONRY EXPERIENCES																						
I	1	Setting up a work area in order to expedite the mixing of concrete on the job.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	2	Cleaning and oiling concrete forms prior to and after their use on a building.																						
II	3	Preparing a batch of cement, plaster, lime mortar and cement-lime mortar by hand and by machine at the construction site.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	4	Shoring sidewalls of earthen ditches to prevent cave-ins during excavation.																						
II	5	Installing rods and spreaders to space form section before pouring cement.																						
I	6	Wiring and bolting forms to prevent spreading during pouring.																						
II	7	Bracing sidewalls of forms to prevent spreading during pouring.																						
I	8	Installing anchor bolts in masonry walls and concrete to provide a place for securing future construction.																						
I	9	Protecting a concrete slab following finishing operations to provide for proper curing.																						
I	10	Erecting scaffolding for use by a mason at the building site.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	11	Cleaning out mortar joints for tuck pointing on a masonry wall.																						

Figure 17, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
			Student																					
I	12	Pointing up a section of a brick wall to provide a finished appearance on a house.																						
I	13	Applying colorless coating to waterproof masonry surfaces above grade on a building.																						
I	14	Applying asphalt coating to waterproof foundation wall below grade on a building.																						
I	15	Pouring a section of footing containing reinforcing rods for a house.																						
I	16	Pouring a small reinforced concrete slab suitable for a porch deck on a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
II	17	Installing footer forms to receive concrete for a foundation.																						
II	18	Setting a section of sidewalk form to receive concrete at a building site.	S	S	S	S	S	S	S	S	S	S	S	S	S									
II	19	Finishing a small concrete slab to provide utility and pleasing appearance.	S	S	S	S	S	S	S	S	S	S	S	S	S									
II	20	Laying cement block for a wall in stretcher courses for a building.																						
		PAINTING EXPERIENCES																						
I	1	Preparing a surface for application of stain on the interior or exterior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	2	Preparing a surface for application of paint on the interior or exterior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
II	3	Preparing a surface for application of a clear finish on the interior or exterior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	4	Removing old finishes in preparation for resurfacing.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	5	Preparing stain and applicator for use on the interior and exterior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
II	6	Preparing paint and applicator for use in painting a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	7	Preparing clear finishes and applicators for use on the exterior and interior of a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	8	Cleaning and storing brushes and rollers following their use in applying finishing materials.	S	S	S	S	S	S	S	S	S	S	S	S	S									
I	9	Glazing a window in preparation for painting.	S	S	S	U	S	S	S	S	S	S	S	U	S									
I	10	Preparing joints and nail holes in dry wall construction to receive final finish.																						
I	11	Applying finishing materials to provide protection and decoration of surfaces in or on a house.	S	S	S	S	S	S	S	S	S	S	S	S	S									

Figure 17, continued

PLUMBING EXPERIENCES

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Digging a trench for plumbing installation in a house.					S	S																
I	2	Backfilling a trench following installation of plumbing lines for a house.					S	S																
I	3	Preparing copper tubing for installation in a plumbing system for a house.					S	S																
I	4	Preparing pipe for installation in a plumbing or gas supply system in a house.																						
I	5	Preparing cast iron soil pipe to pour a lead joint for a waste line in a house.																						
I	6	Preparing lead for pouring soil pipe joints for a house.					S	S																
I	7	Laying a drainage field with clay pipe for a house.					S	S																
I	8	Attaching mounting brackets for plumbing fixtures to frame construction.																						
I	9	Attaching mounting brackets for plumbing fixtures to masonry construction.																						
I	10	Installing a water closet seat in a house.																						
I	11	Insulating heating and water lines in a house.																						
I	12	Assembling a furnace for a house.																						
I	13	Installing duct work for warm air heating system in a house.																						
II	14	Installing plastic pipe for plumbing lines for a house.																						
II	15	Soldering sheet metal and copper tubing to be used in a house.																						
II	16	Repairing leaks in faucets in a house.	S	S	S	U	S	S	S	S	S	S	S	S	S									
II	17	Repairing leaks in a water closet in a house.																						
II	18	Cleaning waste lines with a snake in a house.					S	S																
I	19	Welding angle iron for pipe hangers.																						

Community involvement. Community involvement in the construction cluster at School H was obtained through Teacher H's ability to contract jobs for his students. Several tool and garden sheds were built by students in the construction cluster and erected at sites on private property. This provided the boys with practical experience and also allowed them to use their skills to construct a useful item.

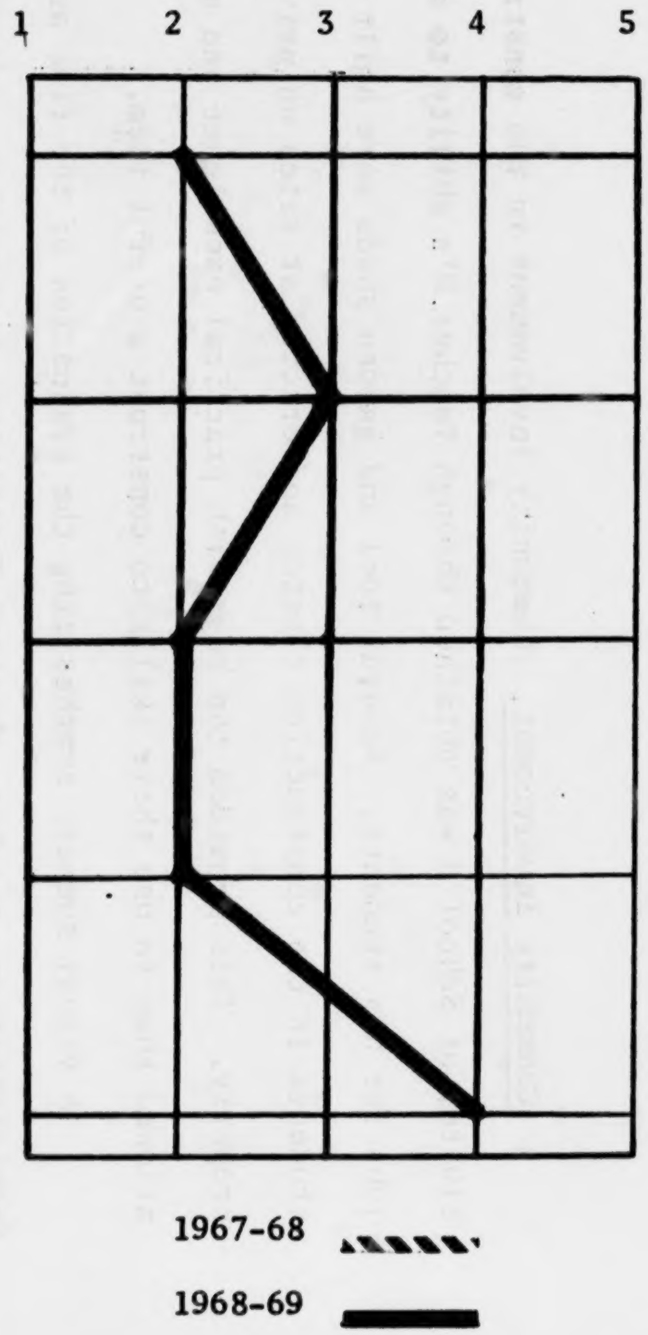
A visual summary synthesizing the evaluation of the five areas, [administration, teacher, physical facilities, instruction, and community involvement] which have been featured in the description of the pilot program at School H, is presented in Figure 18.

Figure 18.

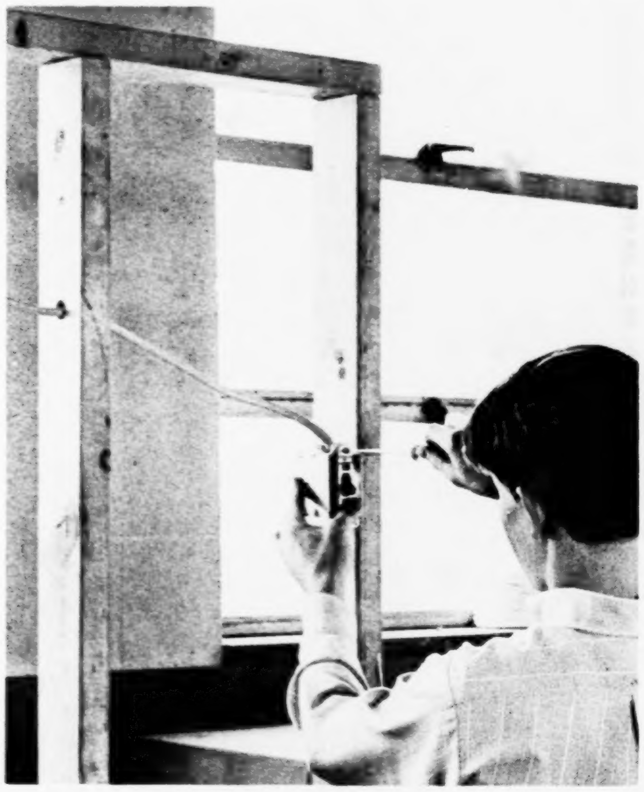
SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL H

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.



CONSTRUCTION CLUSTER ACTIVITIES



EVALUATION OF THE METAL FORMING AND FABRICATION CLUSTER PROGRAM

The metal forming and fabrication cluster was designed to develop within the student, skills and understandings related to the occupation of an assembly worker, a machinist, a sheet metal worker, and a welder. The cluster program was not designed for in-depth development of skills in any one occupation— rather it was directed toward preparing students for entry into any of the occupations within the metal forming and fabrication cluster.

The following objectives were emphasized in the curriculum for the metal forming and fabrication cluster:

1. To broaden the student's understanding of the available opportunities in occupations within the parameters of the metal forming and fabrication cluster.
2. To develop job entry skills and knowledge for all the identified occupations found in the metal formig and fabrication cluster.
3. To develop a favorable attitude toward work activities and problems of the metal forming and fabrication cluster.
4. To develop a student's understanding of the sources of information that will be helpful to him as he moves through the occupational area in and out of school.

The specific objectives for the course are the following:

1. To develop the student's competency in the use of necessary

hand tools required in the metal forming and fabrication cluster.

2. To develop the student's competency in the use of power tools and equipment needed for job entry into the occupations within the metal forming and fabrication cluster.
3. To develop the student's understanding of the operations, procedures, and processes associated with the metal forming and fabrication cluster.
4. To develop safe working habits related to the occupations within the metal forming and fabrication cluster.
5. To familiarize the student with the terminology associated with the metal forming and fabrication cluster.
6. To develop an understanding of the resources available to him in his pursuit of the course as well as in his work following graduation.

Plan of Presentation

In the following section of the report the pilot program of each school will be discussed with reference to the administration, the teacher, the physical facilities, the instruction, and community involvement.

The information reported was obtained by members of the cluster concept project research team through a series of bi-weekly visitations to the various schools involved with pilot programs in the metal forming and fabrication cluster.

Orientation. School B was located in an urban setting although a number of students were from outlying rural areas. Students in grades 10 through 12 were in attendance. The students could select either the college entrance, business, vocational, or general curriculum.

The introduction of the metal forming and fabrication cluster into this school added another dimension to the practical arts curriculum. In addition to the metal forming and fabrication cluster, the other practical areas of the curriculum included courses in business, home economics, industrial arts, plumbing and heating, graphic arts, and agriculture.

The administration. The principal and vice-principal gave continuous support to the cluster concept program and to the teacher. The administration and guidance counselors were extremely helpful with problems involving the scheduling of students' class time and the allotment of additional physical facilities for the laboratory.

The county administration provided little material support for the cluster concept program at School B, although through other overt acts, it supported and encouraged the program. Fortunately, Teacher B was able to conduct the program with equipment and supplies which were on hand for the industrial arts program until the time when requisitioned material began to arrive. At the latter part of 1969 Teacher B was alloted a sum of money to be used for instructional materials by his supervisor of industrial education. This money was used to purchase additional tools, equipment, and materials needed for the cluster concept program.

The teacher. Teacher B had a B.S. degree in Industrial Arts, had completed additional graduate work, plus eight years of teaching experience in woodworking and metal working at the senior high school level. Much of his work experience had been in the area associated with the metal forming and fabrication cluster.

Teacher B was a masterful teacher. His ability to structure experiences and his art of motivating students created the impression that the class would continue to function effectively without his presence. He developed unusual *esprit de corps* in the group. The final report of the third phase presents an example of his influence.

Teacher B's cluster concept program was highly organized and he made maximum use of the available tools, materials, and equipment by incorporating several group and individual projects into the practical part of the program. These projects were discussed in the final report of 1968 and others are presented in the following pages.

Physical facilities. The metal forming and fabrication cluster class at School B shared a laboratory with the agriculture department and utilized the equipment in this facility. This arrangement did not impede the program since the laboratory was of adequate size to provide storage and working space for the group.

Over 75 percent of the recommended materials and equipment were received at School B. These materials plus those on hand for the industrial arts program were more than adequate for the successful implementation of the two-year pilot program.

A detailed drawing of the laboratory in which the cluster program was conducted was presented in the final report of 1968. This drawing also indicated major pieces of equipment and depicted their location in the laboratory. The recommended layout for this laboratory is presented in Figure 19.

Instruction. Sixteen of the original seventeen students enrolled in the metal forming and fabrication cluster in School B completed the program. Instruction was somewhat retarded when several of the students were subsequently enrolled in the work study program at School B. This resulted in the students receiving only one hour of cluster instruction per day. These students enrolled in the work-study program at the beginning of the final semester of the two-year pilot programs.

Despite this unusual situation, it was evident that experience was gained by the students in all occupations of the cluster. Various teaching techniques were used. Where required, initial experiences were obtained by completing small jobs and practice pieces. From this initial work, the students progressed to larger projects, some of which combined tasks from several occupations. In the course of building the projects, Teacher B made a practice of rotating students through the occupations of the cluster in groups of three and four. At other times the line production technique was used. This instruction was supplemented with industrial visitations where the students observed activities directly related to the metal forming and fabrication cluster.

In order to evaluate the performance and progress of each student enrolled in the metal forming and fabrication cluster, a task inventory was developed by the research team. This inventory included a list of all the tasks to be taught in the cluster. When kept up-to-date, it provided an objective record of student progress and achievement to the teacher, parents, students, and employers. Evaluation by the teacher provided data on how well each student in the class performed the occupational tasks of the construction cluster. The cognitive abilities

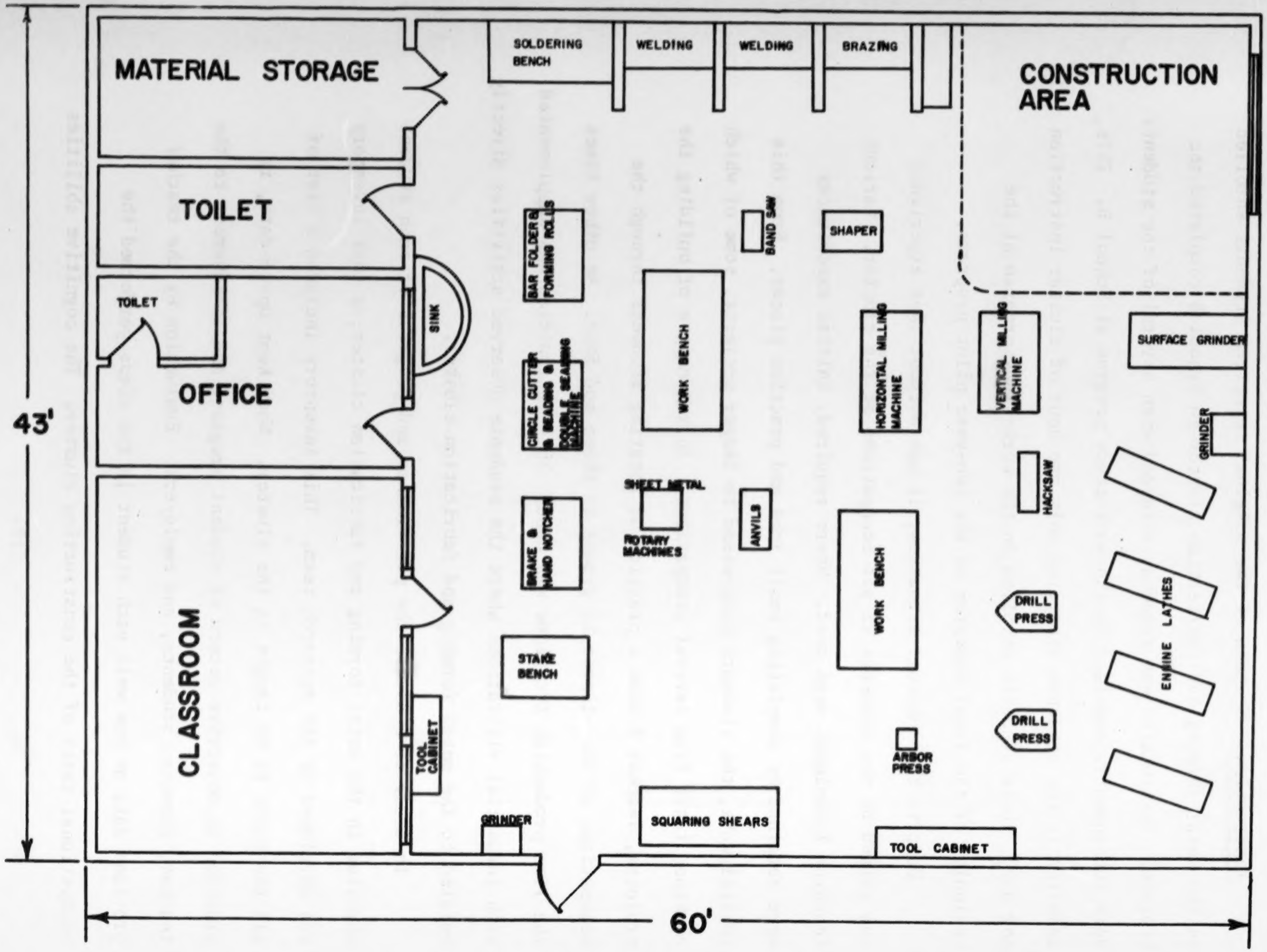


Figure 19. Suggested Floor Plan
Metal Forming and Fabrication Cluster

were measured by the tests. These are presented in Appendix A. Each student was assigned either a satisfactory (S) or unsatisfactory (U) as an index of his achievement. Those tasks not taught were indicated by the letter (N). See Figure 20.

A second instrument for enabling the gathering and reporting of objective data was developed by the research team. This inventory of student abilities and interests was designed primarily to provide guidance counselors and prospective employers a concise and easily understood evaluation of individual students' strengths, abilities, and interests. Included in this instrument were data relevant to interests as reflected by the Minnesota Vocational Interest Inventory, and summary ratings on the task performances indicated by superior, average, or below average. Evaluations of student skills and knowledges in the occupational areas of the cluster program were also summarized. A sample of student abilities and interests inventory is presented in Appendix B.

Community involvement. Several students obtained employment during the summer of 1968 within one of the occupations in the cluster. One company agreed to take seven students as part of a work-study program.

Teacher B was well respected in the community and the program reaped many benefits in the form of supplies, employment for students, and field trips resulting from his relationship with local industries and businessmen.

A visual summary synthesizing the evaluation of the preceding five areas (administration, teacher, physical facilities, instruction, and community involvement) which have been featured in the description of the pilot program at School B is presented in Figure 21.

Figure 20.

TASK INVENTORY, SCHOOL B

TASK EVALUATION CHART

MACHINING EXPERIENCES

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Turning stock on lathe to produce a faced surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	2	Countersinking (countersink and center drill) stock to produce a tapered hole for mounting stock between centers.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	3	Turning stock on lathe to produce a cyclindrical shape to .001 inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	4	Turning stock on lathe to produce a shoulder to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	5	Drilling stock on lathe to produce a hole to .005 of an inch.																						
II	6	Reaming stock on lathe to produce a finished hole to .001 of an inch.	S	U	U	U	U		S								S							
II	7	Boring stock on lathe to produce an enlarged hole to .001 of an inch.																						
II	8	Counterboring stock on lathe to produce a recessed hole to .005 of an inch.															S							
I	9	Parting stock on lathe to produce a piece within 1/32 of an inch.																						
II	10	Necking stock on lathe to produce a necked shape to 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	11	Filing stock on lathe to produce a finished surface.			U	S	S	S		S							S							
I	12	Machining stock on shaper to produce a flat surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	13	Machining stock on shaper to produce two parallel surfaces to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	14	Drilling stock on drill press to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	15	Reaming a hole on drill press to produce a finished hole to .001 of an inch.																						
I	16	Spot facing a hole on drill press to produce a finished surface to .005 of an inch.																						
I	17	Countersinking on drill press to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	18	Counterboring stock on drill press to produce an enlarged hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	19	Grinding stock on bench grinder to remove excess metal.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	20	Grinding drill bits on a bench grinder to sharpen tools.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							

Figure 20, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	21	Grinding stock on surface grinder to produce a flat surface.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	22	Grinding stock on surface grinder to produce two parallel surfaces to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	23	Grinding stock on surface grinder to produce two perpendicular surfaces to .001 of an inch.																						
II	24	Grinding stock on surface grinder to produce an angular surface.																						
I	25	Machining stock on a horizontal milling machine to produce a flat surface.	S	S	U	S	S	S									S							
I	26	Machining stock on a horizontal milling machine to produce parallel surfaces to .001 of an inch.	S	S	U	S	S	S									S							
II	27	Machining stock on a horizontal milling machine to produce two perpendicular surfaces to .001 of an inch.															S							
II	28	Machining stock on a horizontal milling machine to produce a shoulder to .001 of an inch.															S							
II	29	Machining stock on a horizontal milling machine to produce an angular surface.	S	U	U	U	S	S									S							
I	30	Machining stock on a vertical milling machine to produce a flat surface.	S	U	U	U	S	S									S							
I	31	Machining stock on a vertical milling machine to produce two parallel surfaces to .001 of an inch.	S	U	U	U	S	S									S							
II	32	Machining stock on vertical milling machine to produce two perpendicular surfaces to .001 of an inch.																						
II	33	Machining stock on vertical milling machine to produce a shoulder to .001 of an inch.																						
		WELDING EXPERIENCES																						
		Arc welding ferrous metals with A.C. welder to produce:																						
I	1	a horizontal butt joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	2	a horizontal lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	3	a horizontal outside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	4	a horizontal inside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	5	a horizontal tee joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	6	a vertical lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	7	Arc welding pipe stock with A.C. welder to produce a butt joint while fixed.	S	S	U	S	U	U		U							S							
II	8	Arc welding pipe stock with A.C. welder to produce butt joints while rolling.																						

Figure 20, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Arc welding ferrous metals with .C. welder to produce																						
I	9	a horizontal butt joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	10	a horizontal lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	11	a horizontal outside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	12	a horizontal inside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	13	a horizontal tee joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	14	a vertical lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	15	Arc welding pipe stock with D.C. welder to produce butt joints while fixed.	S	S	U	S	U	S									S							
II	16	Arc welding pipe stock with D.C. welder to produce butt joints while rolling.		S																				
I	17	Pad welding low areas on metal stock to renew stock to original height.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
		Gas welding ferrous metals stock to produce:																						
I	18	a horizontal butt joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	19	a horizontal lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	20	a horizontal outside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	21	a horizontal inside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	22	a horizontal tee joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	23	a vertical lap joint.																						
I	24	Gas cutting ferrous carbon steels.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
		Brazing ferrous metals to produce:																						
I	25	a horizontal butt joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	26	a horizontal lap joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	27	a horizontal outside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	28	a horizontal inside corner joint.																						
I	29	a horizontal tee joint.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	30	a vertical lap joint.																						
		Brazing non-ferrous metals to produce:																						
II	31	a horizontal butt joint.																						
II	32	a horizontal lap joint.																						
II	33	a horizontal outside corner joint.																						
II	34	a horizontal inside corner joint.																						
II	35	a horizontal tee joint.																						
II	36	a vertical lap joint.																						

Figure 20, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Inert gas welding ferrous metals to produce:																						
II	37	a horizontal butt joint.	S	S	S	S	S	S		S							S							
II	38	a horizontal lap joint.	S	S	S	S	S	S		S							S							
II	39	a horizontal outside corner joint.	S	S	S	S	S	S		S							S							
II	40	a horizontal inside corner joint.	S	S	S	S	S	S		S							S							
II	41	a horizontal tee joint.	S	S	S	S	S	S		S							S							
II	42	a vertical lap joint.	U	U	U	U	U	U		U							U							
II	43	Inert gas welding pipe stock to produce butt joints while rolling.																						
II	44	Inert gas welding pipe stock to produce butt joints while fixed.	S	S	U	U	U	U		U							S							
		Inert gas welding non-ferrous metals to produce:																						
II	45	a horizontal butt joint.	S																					
II	46	a horizontal lap joint.	S																					
II	47	a horizontal outside corner joint.																						
II	48	a horizontal inside corner joint.																						
II	49	a horizontal tee joint.																						
II	50	a vertical lap joint.																						
II	51	butt joints while rolling																						
II	52	butt joints while fixed																						
		SHEET METAL EXPERIENCES																						
I	1	Tracing templates on sheet metal for cutting, bending and joining sheet metal items.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	2	Cutting sheet metal with hand tools to produce a straight cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	3	Cutting sheet metal with machinery to produce a straight cut within 1/32 of an inch.	S	S	S	S	S	S		S							S							
I	4	Cutting sheet metal with hand tools to produce a circular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S								
II	5	Cutting sheet metal with machinery to produce a circular cut within 1/32 of an inch.																						
I	6	Cutting sheet metal with hand tools to produce an irregular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	7	Cutting sheet metal with machinery to produce an irregular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	8	Cutting sheet metal with hand tools to produce a notched cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							

Figure 20, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	9	Cutting sheet metal with machinery to produce a notched cut within 1/32 of an inch.																						
I	10	Cutting sheet metal to produce an interior cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	11	Forming sheet metal cylindrical shapes on slip roll forming machine.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	12	Forming sheet metal crimping on a crimping machine.																						
I	13	Forming sheet metal beading on a beading machine.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	14	Forming single hem on bar folder or brake for strength.																						
II	15	Forming double hem on bar folder or brake for strength.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	16	Forming single seam on a brake and/or bar folder for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	17	Forming double seam on a brake and/or bar folder for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	18	Forming Pittsburgh lock seam with machinery for joining sheet metal parts.																						
II	19	Forming cap strip seam on a drive cap machine for joining sheet metal parts.																						
I	20	Drilling sheet metal to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	21	Adhering sheet metal parts with adhesives to produce an assembly.																						
II	22	Welding (spot) sheet metal parts to produce an assembly.																						
II	23	Soldering sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	24	Fastening sheet metal parts with sheet metal screws to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
[illegible]	25	Bolting sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	26	Riveting sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
[illegible]	27	Joining sheet metal parts with seams.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
		ASSEMBLY EXPERIENCES																						
[illegible]	1	Adhering parts with adhesives using hand processes to produce a metal bonded assembly																						
II	2	Adhering parts with adhesives using spray equipment to a specified thickness to produce a metal bonded assembly.																						

Figure 20, continued

Level	Task No.	Task Statement	Student A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	3	Fastening metal parts with screws to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	4	Bolting metal parts with screws to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	5	Riveting metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	6	Tightening metal fasteners with hand power tools.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	7	Mating parts together to produce sub-assemblies.	S	S		S	S	S		S							S							
II	8	Mating parts and sub-assemblies together to produce major assemblies.	S	S		S	S	S		S							S							
I	9	Holding parts in clamping devices for assembly of details, sub-assemblies and assemblies.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	10	Cutting materials with hand tools to fit in an assembly.	S	S	S	S	S	S		S	S			S	S		S							
II	11	Cutting materials with power tools to fit in an assembly to 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	12	Filing stock to produce a finished assembly to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	13	Drilling holes in material with hand drill to produce a hole to .005 of an inch.																						
I	14	Drilling holes with a hand power drill to produce a hole to .005 of an inch.																						
II	15	Reaming stock with hand wrench to produce a finished hole to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	16	Reaming stock with power drill to produce a finished hole to .001 of an inch.																						
I	17	Countersinking holes with hand tools to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	18	Countersinking holes with power drill to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	19	Tapping holes with taps to produce a threaded hole.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	20	Cutting threads with dies to produce a threaded member.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	21	Punching materials with hand punches to produce a hole.																						
II	22	Punching materials with power tools to produce an assembly.																						

Figure 20, continued

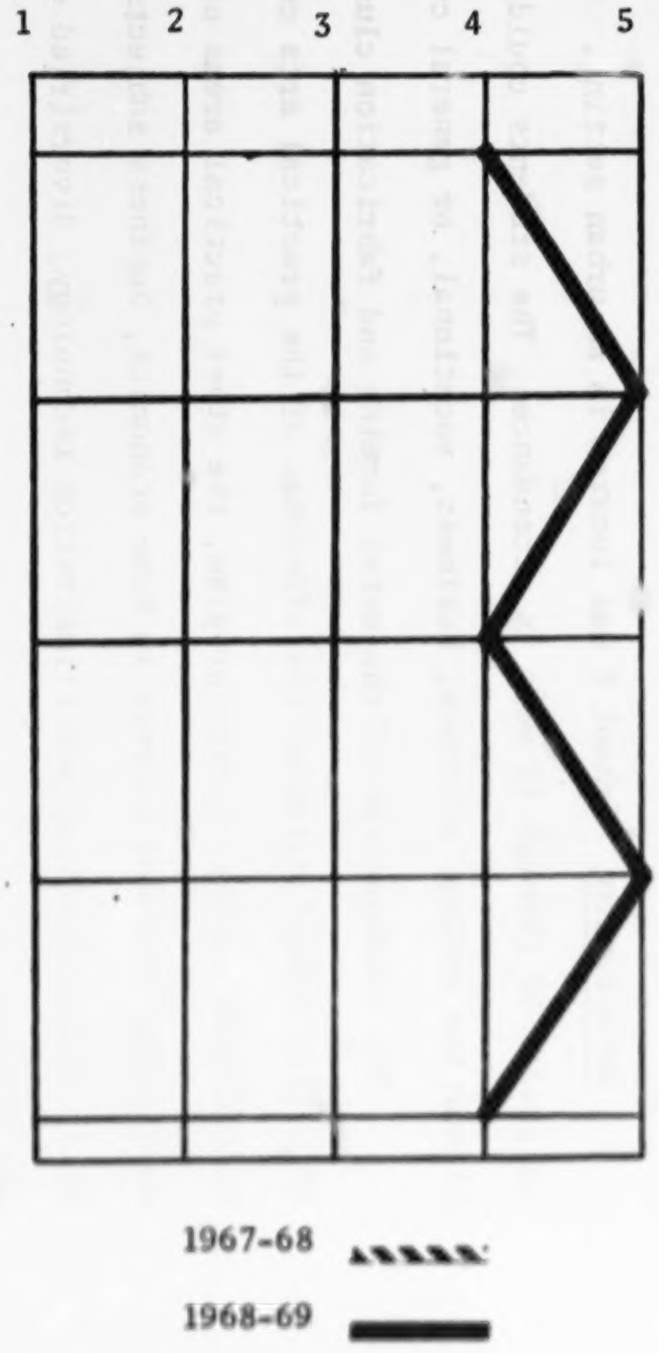
Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	23	Checking dimensions of details with precision instruments for accurate assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	24	Checking dimensions of sub-assemblies and assemblies to produce accurate assemblies.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	25	Measuring stock with precision instruments for assembly.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	26	Stamping number and letters on metal stock for identification.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
I	27	Hammering appropriate metal parts with various hammers.	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S							
II	28	Flaring metal tubing with a flaring tool to produce a flare.	S				S										S							
II	29	Aligning parts in sub-assemblies and assemblies with hand tools.	S	S			S										S							

Figure 21.

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL B

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.



Orientation. School E was located in an urban setting. Students in grades 10 through 12 were in attendance. The students could select either the college entrance, business, vocational, or general curriculum.

The introduction of the metal forming and fabrication cluster into this school extended the offerings of the practical arts curriculum. In addition to the cluster program, the other practical areas of the curriculum included courses in home economics, business subjects, graphic arts, design-drafting and illustration technology, diversified occupations, and industrial arts.

The administration. The administration of School E gave substantial support to the cluster concept program and to the teacher. The principal and the guidance counselor were especially cooperative in eradicating scheduling problems which occurred during the first few weeks of the pilot program.

The county administration also supported the program. Several major pieces of equipment, including a heli-arc welder, were obtained to supplement those already on hand.

The industrial education supervisor was always available for scheduled visits with the research assistants and field programs.

The teacher. Teacher E had a B.S. degree with a major in History and had attended a year of graduate school to become certified in Industrial Education. He had three years teaching experience at the senior high school level.

Teacher E's armed forces experience in aircraft riveting, welding, and sheet metal layout was particularly applicable to the metal forming and fabrication cluster as was his summer work experience with Pratt and Whitney Aricraft Company.

Teacher E's class was always well organized and engaged in purposeful activities. He was observed to be very thorough in teaching the occupational tasks in the metal forming and fabrication cluster.

Physical facilities. The size of the laboratory at School E was rather small and as a result restricted some of the activities of this cluster. See final report of phase III. By conducting a survey, it was found that considerable amounts of tools, materials, and equipment still needed to be added to bring the inventory up to the level recommended for the metal forming and fabrication cluster. When informed of this survey, the supervisor obtained most of the needed items. Several new pieces of equipment were added during the school year. This cluster program operated with over 85 percent of the recommended tools, materials, and equipment.

A detailed drawing of the laboratory in which the cluster program at School E was conducted was presented in the final report of phase III. This drawing also showed major pieces of equipment and their location in the laboratory. The recommended layout and specifications for such a program are presented in Figure 19.

Instruction. The students obtained a broad experience in the metal forming and fabrication cluster through satisfactory performance of tasks in all the occupations of the cluster. Several large projects were constructed which integrated experiences from each of the major areas of the cluster. Two examples of this type of project were a utility trailer and a working model steam engine. Several types of practice pieces were utilized as were numerous smaller projects which were central to the practical part of the instruction.

There were eighteen students enrolled in the cluster program at School E at the beginning of the two-year pilot program. However, only eight of those students completed the program. Casualties were due to the fact that a large number of the subjects graduated after phase III and did not complete phase IV.

In order to evaluate the performance and progress of each student enrolled in the metal forming and fabrication cluster, a task inventory was developed by the research team. This inventory included a list of all the tasks to be taught in the cluster. When kept up-to-date, it provided an objective record of student progress and achievement to the teacher, parents, students, and employers. Evaluation by the teacher provided data on how well each student in the class performed the occupational tasks of the construction cluster. The cognitive abilities were measured by the tests. These are provided in Appendix A. .Each student was assigned either a satisfactory (S) or unsatisfactory (U) as an index of his achievement. Those tasks not taught were signified by a blank space on the chart. See Figure 22.

A second instrument for enabling the gathering and reporting of objective data was developed by the research team. This inventory of student abilities and interests was designed primarily to provide guidance counselors and prospective employers a concise and easily understood evaluation of individual students' strengths, abilities, and interests. Included in this instrument were data relevant to interests as reflected by the Minnesota Vocational Interest Inventory, and summary ratings on the task performances indicated by superior, average, or below average. Evaluations of student skills and knowledges in the occupational areas of the cluster program were also summarized. A sample student abilities and interests in the form of an inventory is presented in Appendix B.

Figure 22.

TASK INVENTORY, SCHOOL E

TASK EVALUATION CHART

MACHINING EXPERIENCES

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Turning stock on lathe to produce a faced surface.	S	S	S	S	S	S	S	S	U													
I	2	Countersinking (countersink and center drill) stock to produce a tapered hole for mounting stock between centers.	S	S	S	S	S	S	S	S	U													
I	3	Turning stock on lathe to produce a cyclindrical shape to .001 inch.	S	S	S	S	S	S	S	S	U													
I	4	Turning stock on lathe to produce a shoulder to .001 of an inch.	S	S	S	S	S	S	S	S	S													
I	5	Drilling stock on lathe to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	U													
II	6	Reaming stock on lathe to produce a finished hole to .001 of an inch.	S	S	S	U	U	S	U	U	U													
II	7	Boring stock on lathe to produce an enlarged hole to .001 of an inch.																						
II	8	Counterboring stock on lathe to produce a recessed hole to .005 of an inch.																						
I	9	Parting stock on lathe to produce a piece within 1/32 of an inch.	U	S	S	U	U	S	U	U	U													
II	10	Necking stock on lathe to produce a necked shape to 1/32 of an inch.	U	S	S	U	U	S	U	U	U													
I	11	Filing stock on lathe to produce a finished surface.	S	S	S	U	S	S	S	S	S													
I	12	Machining stock on shaper to produce a flat surface.	S	S	S	U	U	S	S	S	U													
I	13	Machining stock on shaper to produce two parallel surfaces to .005 of an inch.	S	S	S	U	U	S	S	S	U													
I	14	Drilling stock on drill press to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S													
II	15	Reaming a hole on drill press to produce a finished hole to .001 of an inch.	S	S	S	S	S	S	U	S	S													
I	16	Spot facing a hole on drill press to produce a finished surface to .005 of an inch.	S	S	S	U	U	S	U	S	U													
I	17	Countersinking on drill press to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S													
II	18	Counterboring stock on drill press to produce an enlarged hole to .005 of an inch.	S	S	S	U	U	S	S	S	U													
I	19	Grinding stock on bench grinder to remove excess metal.	S	S	S	S	S	S	S	S	S													
I	20	Grinding drill bits on a bench grinder to sharpen tools.	U	S	S	U	U	S	U	U	U													

Figure 22, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	21	Grinding stock on surface grinder to produce a flat surface.	S	S	S	S	S	S	U	S	U													
I	22	Grinding stock on surface grinder to produce two parallel surfaces to .001 of an inch.	S	S	S	S	S	S	U	S	U													
II	23	Grinding stock on surface grinder to produce two perpendicular surfaces to .001 of an inch.	S	S	S	S	S	S	U	S	U													
II	24	Grinding stock on surface grinder to produce an angular surface.	S	S	S	S	S	S	U	S	U													
I	25	Machining stock on a horizontal milling machine to produce a flat surface.	S	S	S	U	S	S	S	U	U													
I	26	Machining stock on a horizontal milling machine to produce parallel surfaces to .001 of an inch.	S	S	S	U	S	S	S	U	U													
II	27	Machining stock on a horizontal milling machine to produce two perpendicular surfaces to .001 of an inch.	S	S	S	U	S	S	S	U	U													
II	28	Machining stock on a horizontal milling machine to produce a shoulder to .001 of an inch.	S	S	S	U	S	S	S	U	U													
II	29	Machining stock on a horizontal milling machine to produce an angular surface.	S	S	S	U	S	S	S	U	U													
I	30	Machining stock on a vertical milling machine to produce a flat surface.	S	S	S	U	S	S	S	U	U													
I	31	Machining stock on a vertical milling machine to produce two parallel surfaces to .001 of an inch.	S	S	S	U	S	S	S	U	U													
II	32	Machining stock on vertical milling machine to produce two perpendicular surfaces to .001 of an inch.	S	S	S	U	S	S	S	U	U													
II	33	Machining stock on vertical milling machine to produce a shoulder to .001 of an inch.	S	S	S	U	S	S	S	U	U													
		WELDING EXPERIENCES																						
		Arc welding ferrous metals with A.C. welder to produce:																						
I	1	a horizontal butt joint.	S	U	S	U	U	S	S	S	S													
I	2	a horizontal lap joint.	S	U	S	U	U	S	S	S	S													
I	3	a horizontal outside corner joint.	S	U	S	U	U	S	S	S	S													
I	4	a horizontal inside corner joint.	S	U	S	U	U	S	S	S	S													
I	5	a horizontal tee joint.	S	U	S	U	U	S	S	S	S													
I	6	a vertical lap joint.	S	U	S	U	U	U	U	U	U													
II	7	Arc welding pipe stock with A.C. welder to produce a butt joint while fixed.	S	U	S	U	U	S	S	S	U													
II	8	Arc welding pipe stock with A.C. welder to produce butt joints while rolling.	S	U	S	U	U	S	S	S	U													

Figure 22, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Arc welding ferrous metals with D.C. welder to produce																						
I	9	a horizontal butt joint.																						
I	10	a horizontal lap joint.																						
I	11	a horizontal outside corner joint.																						
I	12	a horizontal inside corner joint.																						
I	13	a horizontal tee joint.																						
I	14	a vertical lap joint.																						
II	15	**Arc welding pipe stock with D.C. welder to produce butt joints while fixed.**																						
II	16	**Arc welding pipe stock with D.C. welder to produce butt joints while rolling.**																						
I	17	**Pad welding low areas on metal stock to renew stock to original height.**																						
		Gas welding ferrous metals stock to produce:																						
I	18	a horizontal butt joint.																						
I	19	a horizontal lap joint.																						
I	20	a horizontal outside corner joint.																						
I	21	a horizontal inside corner joint.																						
I	22	a horizontal tee joint.																						
I	23	a vertical lap joint.																						
I	24	**Gas cutting ferrous carbon steels.**	S	S	S	U	U	U	U	U	U													
		Brazing ferrous metals to produce:																						
I	25	a horizontal butt joint.																						
I	26	a horizontal lap joint.	S	S	S	U	U	S	U	S	U													
I	27	a horizontal outside corner joint.	S	S	S	U	U	S	U	S	U													
I	28	a horizontal inside corner joint.	S	S	S	U	U	S	U	S	U													
I	29	a horizontal tee joint.	S	S	S	U	U	S	U	S	U													
I	30	a vertical lap joint.	U	S	S	U	U	S	U	U	U													
		Brazing non-ferrous metals to produce:																						
II	31	a horizontal butt joint.																						
II	32	a horizontal lap joint.	S	S	S	U	U	S	U	S	U													
II	33	a horizontal outside corner joint.	S	S	S	U	U	S	U	S	U													
II	34	a horizontal inside corner joint.	S	S	S	U	U	S	U	S	U													
II	35	a horizontal tee joint.	S	S	S	U	U	S	U	S	U													
II	36	a vertical lap joint.	U	S	S	U	U	S	U	U	U													

Figure 22, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
			Student																					
		Inert gas welding ferrous metals to produce:																						
II	37	a horizontal butt joint.																						
II	38	a horizontal lap joint.																						
II	39	a horizontal outside corner joint.																						
II	40	a horizontal inside corner joint.																						
II	41	a horizontal tee joint.																						
II	42	a vertical lap joint.																						
II	43	Inert gas welding pipe stock to produce butt joints while rolling.																						
II	44	Inert gas welding pipe stock to produce butt joints while fixed.																						
		Inert gas welding non-ferrous metals to produce:																						
II	45	a horizontal butt joint.																						
II	46	a horizontal lap joint.																						
II	47	a horizontal outside corner joint.																						
II	48	a horizontal inside corner joint.																						
II	49	a horizontal tee joint.																						
II	50	a vertical lap joint.																						
II	51	butt joints while rolling																						
II	52	butt joints while fixed																						
		SHEET METAL EXPERIENCES																						
I	1	Tracing templates on sheet metal for cutting, bending and joining sheet metal items.	S	S	S	S	S	S	S	S	S													
I	2	Cutting sheet metal with hand tools to produce a straight cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S													
II	3	Cutting sheet metal with machinery to produce a straight cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S													
I	4	Cutting sheet metal with hand tools to produce a circular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S													
II	5	Cutting sheet metal with machinery to produce a circular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S													
I	6	Cutting sheet metal with hand tools to produce an irregular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S													
II	7	Cutting sheet metal with machinery to produce an irregular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S													
I	8	Cutting sheet metal with hand tools to produce a notched cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S													

Figure 22, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	9	Cutting sheet metal with machinery to produce a notched cut within 1/32 of an inch.																						
I	10	Cutting sheet metal to produce an interior cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	U													
II	11	Forming sheet metal cylindrical shapes on slip roll forming machine.	S	S	S	S	S	S	S	S	U													
I	12	Forming sheet metal crimping on a crimping machine.																						
I	13	Forming sheet metal beading on a beading machine.																						
II	14	Forming single hem on bar folder or brake for strength.	S	S	S	S	S	S	S	S	U													
II	15	Forming double hem on bar folder or brake for strength.	S	S	S	S	S	S	S	S	U													
II	16	Forming single seam on a brake and/or bar folder for joining sheet metal parts.	S	S	S	S	S	S	S	S	U													
II	17	Forming double seam on a brake and/or bar folder for joining sheet metal parts.	S	S	S	S	S	S	S	S	U													
II	18	Forming Pittsburgh lock seam with machinery for joining sheet metal parts.	S	S	S	U	S	S	S	S	U													
II	19	Forming cap strip seam on a drive cap machine for joining sheet metal parts.	S	S	S	S	S	S	S	S	U													
I	20	Drilling sheet metal to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	U													
II	21	Adhering sheet metal parts with adhesives to produce an assembly.	S	S	S	S	S	S	S	S	U													
II	22	Welding (spot) sheet metal parts to produce an assembly.	S	S	S	U	U	S	U	U	U													
II	23	Soldering sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	U													
I	24	Fastening sheet metal parts with sheet metal screws to produce an assembly.	S	S	S	S	S	S	S	S	U													
	25	Bolting sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	U													
II	26	Riveting sheet metal parts to produce an assembly.	S	S	S	U	S	S	S	S	U													
	27	Joining sheet metal parts with seams.	S	S	S	S	S	S	S	S	U													
		ASSEMBLY EXPERIENCES																						
	1	Adhering parts with adhesives using hand processes to produce a metal bonded assembly	S	S	S	S	S	S	S	S	U													
II	2	Adhering parts with adhesives using spray equipment to a specified thickness to produce a metal bonded assembly.																						

Figure 22, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	3	Fastening metal parts with screws to produce an assembly.	S	S	S	S	S	S	S	S	U													
I	4	Bolting metal parts with screws to produce an assembly.	S	S	S	S	S	S	S	S	U													
I	5	Riveting metal parts to produce an assembly.	S	S	S	U	S	S	S	S	U													
I	6	Tightening metal fasteners with hand power tools.																						
II	7	Mating parts together to produce sub-assemblies.	S	S	S	S	S	S	S	S	U													
II	8	Mating parts and sub-assemblies together to produce major assemblies.	S	S	S	S	S	S	S	S	U													
I	9	Holding parts in clamping devices for assembly of details, sub-assemblies and assemblies.	S	S	S	S	S	S	S	S	U													
II	10	Cutting materials with hand tools to fit in an assembly.	S	S	S	S	S	S	S	S	U													
II	11	Cutting materials with power tools to fit in an assembly to 1/32 of an inch.	S	S	S	S	S	S	S	S	U													
I	12	Filing stock to produce a finished assembly to .001 of an inch.	S	S	S	S	S	S	S	U	U													
I	13	Drilling holes in material with hand drill to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	U													
I	14	Drilling holes with a hand power drill to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	U													
II	15	Reaming stock with hand wrench to produce a finished hole to .001 of an inch.	S	S	S	U	S	S	S	S	U													
II	16	Reaming stock with power drill to produce a finished hole to .001 of an inch.	S	S	S	U	S	S	S	S	U													
I	17	Countersinking holes with hand tools to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	U													
I	18	Countersinking holes with power drill to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	U													
II	19	Tapping holes with taps to produce a threaded hole.	S	S	S	S	S	S	S	S	U													
II	20	Cutting threads with dies to produce a threaded member.	S	S	S	S	S	S	S	S	U													
II	21	Punching materials with hand punches to produce a hole.																						
II	22	Punching materials with power tools to produce an assembly.																						

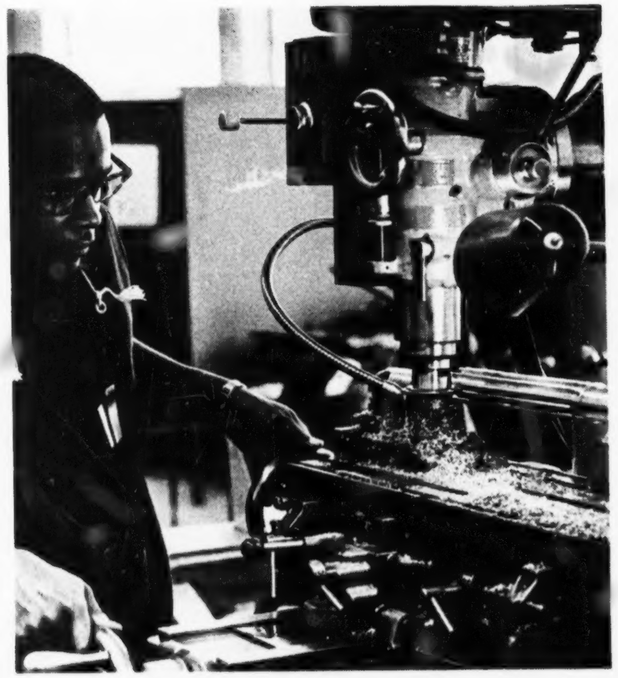
Figure 22, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	23	Checking dimensions of details with precision instruments for accurate assembly.	S	S	S	U	U	S	S	S	U													
I	24	Checking dimensions of sub-assemblies and assemblies to produce accurate assemblies.	S	S	S	U	U	S	S	S	U													
II	25	Measuring stock with precision instruments for assembly.	S	S	S	U	U	S	S	U	U													
I	26	Stamping number and letters on metal stock for identification.	S	S	S	S	S	S	S	S	S													
I	27	Hammering appropriate metal parts with various hammers.	S	S	S	S	S	S	S	S	S													
II	28	Flaring metal tubing with a flaring tool to produce a flare.		S	S	U	U	S	S	S	S													
II	29	Aligning parts in sub-assemblies and assemblies with hand tools.	S	S	S	S	S	S	S	S	S													

Community involvement. The cluster class at School E took several field trips to industrial firms with activities related to the occupations of this cluster. The class participated in an exhibition of work at an educational exhibit in the county. During the first year of the two-year pilot program, several of the students obtained employment in the community in one of the occupational areas of the cluster.

A visual summary synthesizing the evaluation of the five areas (administration, teacher, physical facilities, instruction, and community involvement) which have been discussed in the description of the pilot program at School E is presented in Figure 23.

METAL FORMING AND FABRICATION CLUSTER ACTIVITIES



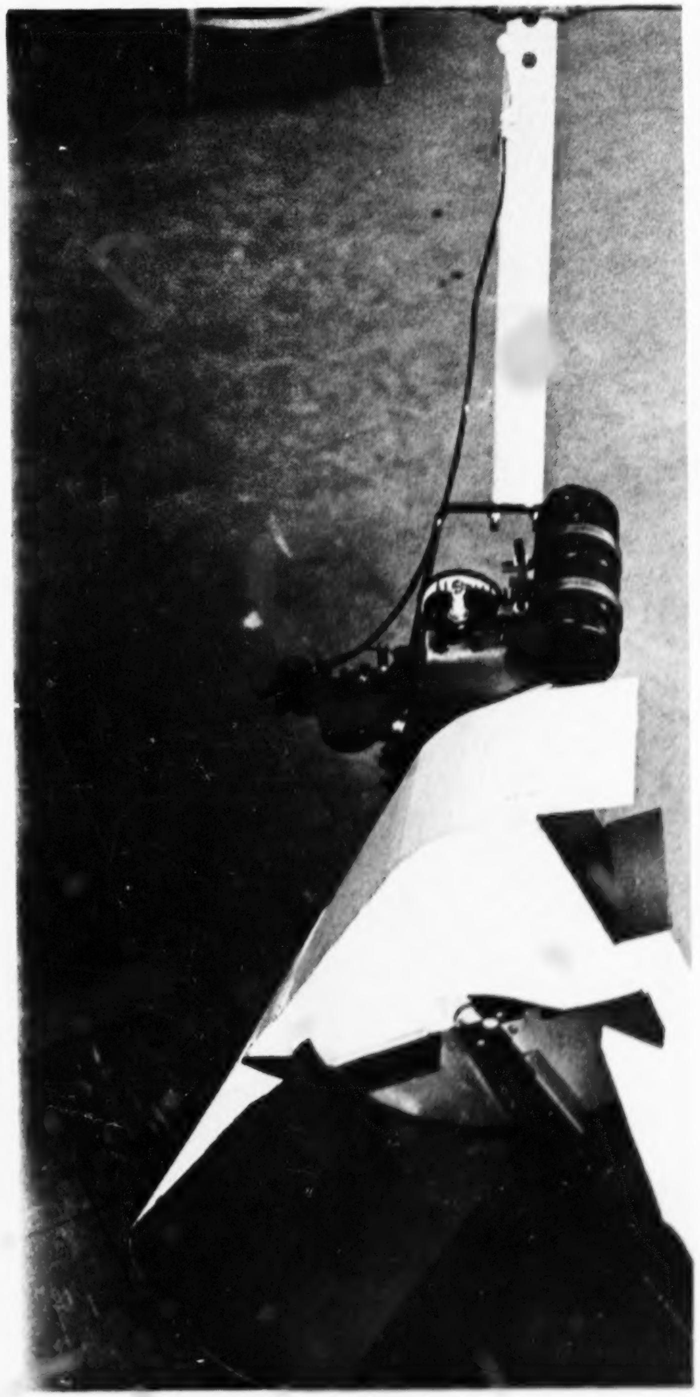
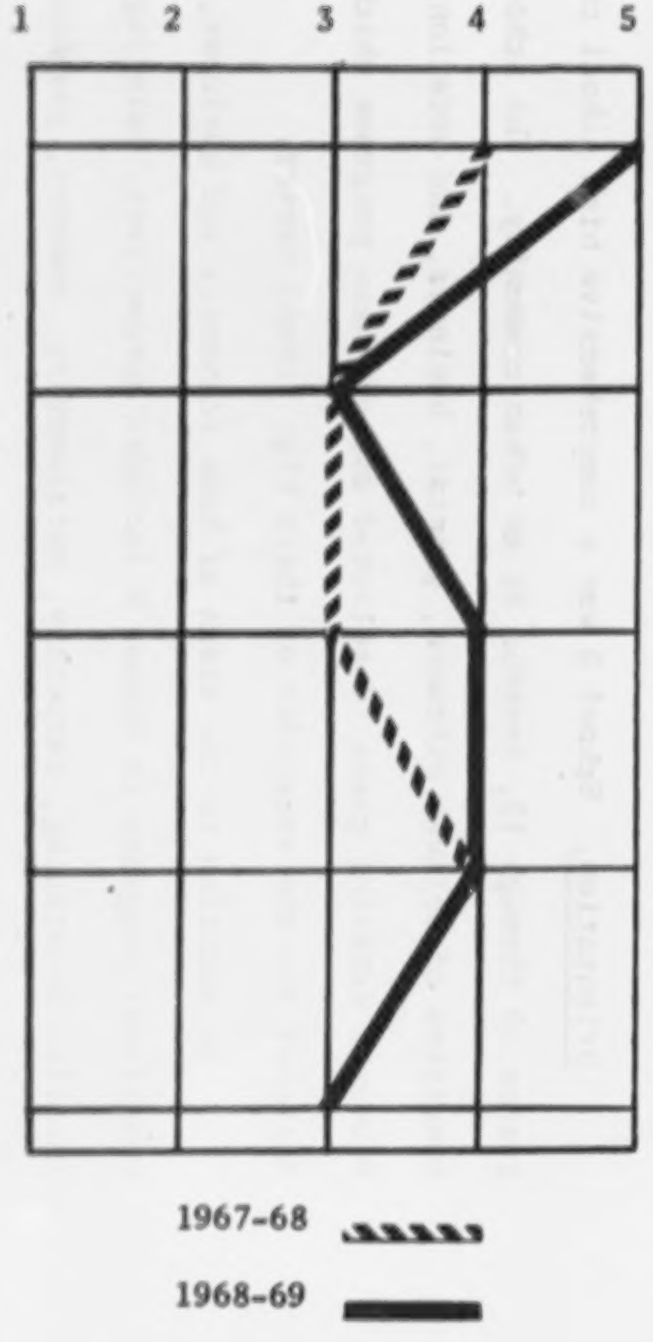


Figure 23.

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL E

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. The experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.



Orientation. School D was a comprehensive high school composed of grades 10 through 12, located in an urban community. The school program consisted of college entrance, general, business, and vocational curriculums. Students entering grade 10 selected one of these programs which they followed for the remainder of their high school career.

In addition to the areas of home economics and business, the other vocational programs in School D included automotives, painting and interior decorating, carpentry, metalworking, masonry, graphic arts, and cosmetology. School D also had industrial arts courses and a construction cluster program.

The introduction of the cluster concept program into this school enabled those students enrolled in the general program to elect a course which would provide them with technical skills, while not tracking them into the one-occupation type vocational program. School D offered two different cluster program--the construction cluster taught by Teacher D (described in a previous section) and the metal forming and fabrication cluster taught by Teacher F.

The administration. The school administration was one of the early supporters of the cluster concept idea during phase I. Teacher F received aid from the administration in resolving problems of enrollment and scheduling.

Due to a very tight schedule the supervisor was able to meet only once with the research team and the principal investigator during the year. The thrust of support from this supervisor came in terms of providing the necessary tools, equipment, and materials for implementing the metal forming and fabrication cluster at School D.

The teacher. Teacher F had a B.S. degree with a major in vocational-industrial education. He had eight years teaching experience in the field of general metals. His service in the army as an officer and trainer of newly assigned soldiers was valuable as was his five and one-half years work as a machinist.

Teacher F had very good rapport with his students and did a commendable job of initiating the cluster concept in his school. He followed the course outline closely and provided theoretical and practical instruction in all the occupations in the cluster. His laboratory was always in order and student activities always gave evidence of well planned and organized procedures.

Physical facilities. The laboratory facility at School D was of sufficient size to accommodate the diverse activities called for in the metal forming and fabrication cluster. It was well equipped and contained about 90 percent of the items recommended for the program at the beginning of the first year of the two-year pilot program. At the beginning of the second year several pieces of major equipment were replaced or added to the existing equipment. Unfortunately, the heli-arc welder which was obtained during the Spring of1968 was never properly serviced and as a result it could not beused by the class.

A detailed drawing of the laboratory in which thecluster program was conducted was presented in the final report of phase III. This drawing also depicted major pieces of equipment and indicated their location in the laboratory. The recommended facilities are presented in Figure 10.

Instruction. Only eight of the original sixteen students who were enrolled in the cluster program at School D completed the two-year pilot program. Several seniors formed the original group. After phase III they graduated, reducing the amount of subjects in phase IV. These students gained experience in all occupations of the metal forming and fabrication cluster. This group of students was observed to be quite industrious and absorbed in their work. Their activities were well organized and coordinated with the structured course requirements.

In order to evalute the performance and progress of each student enrolled in the metal forming and fabrication cluster, a task inventory was developed by the research team. This inventory included a list of all the tasks to be taught in the cluster. When kept up-to-date, it provided an objective record of student progress and achievement to the teacher, parents, students, and employers. Evaluation by the teacher provided data on how well each student in the class performed the occupational tasks of the construction cluster. The cognitive abilities were measured by the tests. These are provided in Appendix A. Each student was assigned either a satisfactory (S) or unsatisfactory (U) as an index of his achievement. Those tasks not taught were signified by a blank space on the chart. See Figure 24.

A second instrument for enabling the gathering and reporting of objective data was developed by the research team. This inventory of student abilities and interests was designed primarily to provide guidance counselors and prospective employers a concise and easily understood evaluation of individual students' strengths, abilities, and interests. Included in this instrument were data relevant to interests as reflected by the Minnesota Vocational Interest

Inventory, and summary ratings on the task performances indicated by superior, average, or below average. Evaluations of student skills and knowledges in the occupational areas of the cluster program were also summarized. A sample student abilities and interests inventory is presented in Appendix B.

Community involvement. Several of the students in the metal forming and fabrication cluster at School D obtained employment in the community during the Summer of 1968. Information regarding employment after graduation is presented in the section devoted to this topic.

There were a number of field trips taken to industrial firms engaged in one or more of the occupations included in this cluster.

A visual summary synthesizing the evaluation of the five areas (administration, teacher, physical facilities, instruction, and community involvement) which have been discussed in the description of the metal forming and fabrication cluster program at School D, is presented in Figure 25.

Figure 24.

TASK EVALUATION CHART

TASK INVENTORY, SCHOOL D, TEACHER F

MACHINING EXPERIENCES

Level	Task No.	Task Statement	Student A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
[illegible]	1	Turning stock on lathe to produce a faced surface.	S	S	S	S	S	S	S															
[illegible]	2	Countersinking (countersink and center drill) stock to produce a tapered hole for mounting stock between centers.	S	S	S	S	S	S	S															
[illegible]	3	Turning stock on lathe to produce a cylindrical shape to .005 inch.	S	S	S	S	S	S	S															
[illegible]	4	Turning stock on lathe to produce a shoulder to .005 of an inch.	S	S	S	S	S	S	S															
[illegible]	5	Drilling stock on lathe to produce a hole to .005 of an inch.	S	S	S	S	S	S	S															
[illegible]	6	Reaming stock on lathe to produce a finished hole to .001 of an inch.				S	S	S	S															
[illegible]	7	Boring stock on lathe to produce an enlarged hole to .005 of an inch.				S	S	S	S															
[illegible]	8	Counterboring stock on lathe to produce a recessed hole to .005 of an inch.				S	S	S	S															
[illegible]	9	Parting stock on lathe to produce a piece within 1/32 of an inch.	S	S	S	S	S	S	S															
[illegible]	10	Knurling stock on lathe to produce a knurled shape to 1/32 of an inch.				S	S	S	S															
[illegible]	11	Filing stock on lathe to produce a finished surface.	S	S	S	S	S	S	S															
[illegible]	12	Machining stock on shaper to produce a flat surface.	S	S	S	S	S	S	S															
[illegible]	13	Machining stock on shaper to produce two parallel surfaces to .005 of an inch.	S	S	S	S	S	S	S															
[illegible]	14	Drilling stock on drill press to produce a hole to .005 of an inch.	S	S	S	S	S	S	S															
[illegible]	15	Reaming a hole on drill press to produce a [illegible]				S	S	S	S															
[illegible]	16	Spot facing a hole on drill press to produce a finished surface to .005 of an inch.	S	S	S	S	S	S	S															
[illegible]	17	Countersinking on drill press to produce a fastener receiver hole.	S	S	S	S	S	S	S															
[illegible]	18	Counterboring stock on drill press to produce an enlarged hole to .005 of an inch.				S	S	S	S															
[illegible]	19	Grinding stock on bench grinder to remove excess metal.	S	S	S	S	S	S	S															
[illegible]	20	Grinding drill bits on a bench grinder to sharpen tools.	S	S	S	S	S	S	S															

Figure 24, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	21	Grinding stock on surface grinder to produce a flat surface.	S	S	S	S	S	S	S															
I	22	Grinding stock on surface grinder to produce two parallel surfaces to .001 of an inch.	S	S	S	S	S	S	S															
II	23	Grinding stock on surface grinder to produce two perpendicular surfaces to .001 of an inch.				S	S	S	S															
II	24	Grinding stock on surface grinder to produce an angular surface.				S	S	S	S															
I	25	Machining stock on a horizontal milling machine to produce a flat surface.	S	S	S	S	S	S	S															
I	26	Machining stock on a horizontal milling machine to produce parallel surfaces to .001 of an inch.	S	S	S	S	S	S	S															
II	27	Machining stock on a horizontal milling machine to produce two perpendicular surfaces to .001 of an inch.				S	S	S	S															
II	28	Machining stock on a horizontal milling machine to produce a shoulder to .001 of an inch.				S	S	S	S															
II	29	Machining stock on a horizontal milling machine to produce an angular surface.				S	S	S	S															
I	30	Machining stock on a vertical milling machine to produce a flat surface.	S	S	S	S	S	S	S															
I	31	Machining stock on a vertical milling machine to produce two parallel surfaces to .001 of an inch.	S	S	S	S	S	S	S															
II	32	Machining stock on vertical milling machine to produce two perpendicular surfaces to .001 of an inch.				S	S	S	S															
II	33	Machining stock on vertical milling machine to produce a shoulder to .001 of an inch.				S	S	S	S															
		WELDING EXPERIENCES																						
		Arc welding ferrous metals with A.C. welder to produce:																						
I	1	a horizontal butt joint.	S	S	S	S	S	S	S															
I	2	a horizontal lap joint.	S	S	S	S	S	S	S															
I	3	a horizontal outside corner joint.	S	S	S	S	S	S	S															
I	4	a horizontal inside corner joint.	S	S	S	S	S	S	S															
I	5	a horizontal tee joint.	S	S	S	S	S	S	S															
I	6	a vertical lap joint.	S	S	S	S	S	S	S															
II	7	Arc welding pipe stock with A.C. welder to produce a butt joint while fixed.				S	S	S	S															
II	8	Arc welding pipe stock with A.C. welder to produce butt joints while rolling.				S	S	S	S															

Figure 24, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Arc welding ferrous metals with D.C. welder to produce																						
I	9	a horizontal butt joint.	S	S	S	S	S	S	S															
I	10	a horizontal lap joint.	S	S	S	S	S	S	S															
I	11	a horizontal outside corner joint.	S	S	S	S	S	S	S															
I	12	a horizontal inside corner joint.	S	S	S	S	S	S	S															
I	13	a horizontal tee joint.	S	S	S	S	S	S	S															
I	14	a vertical lap joint.	S	S	S	S	S	S	S															
II	15	Arc welding pipe stock with D.C. welder to produce butt joints while fixed.				S	S	S	S															
II	16	Arc welding pipe stock with D.C. welder to produce butt joints while rolling.				S	S	S	S															
I	17	Pad welding low areas on metal stock to raise stock to original height.	S	S	S	S	S	S	S															
		Gas welding ferrous metals stock to produce:																						
I	18	a horizontal butt joint.	S	S	S	S	S	S	S															
I	19	a horizontal lap joint.	S	S	S	S	S	S	S															
I	20	a horizontal outside corner joint.	S	S	S	S	S	S	S															
I	21	a horizontal inside corner joint.	S	S	S	S	S	S	S															
I	22	a horizontal tee joint.	S	S	S	S	S	S	S															
I	23	a vertical lap joint.	S	S	S	S	S	S	S															
I	24	Gas cutting ferrous carbon steels.	S	S	S	S	S	S	S															
		Brazing ferrous metals to produce:																						
I	25	a horizontal butt joint.	S	S	S	S	S	S	S															
I	26	a horizontal lap joint.	S	S	S	S	S	S	S															
I	27	a horizontal outside corner joint.	S	S	S	S	S	S	S															
I	28	a horizontal inside corner joint.	S	S	S	S	S	S	S															
I	29	a horizontal tee joint.	S	S	S	S	S	S	S															
I	30	a vertical lap joint.	S	S	S	S	S	S	S															
		Brazing non-ferrous metals to produce:																						
II	31	a horizontal butt joint.				S	S	S	S															
II	32	a horizontal lap joint.				S	S	S	S															
II	33	a horizontal outside corner joint.				S	S	S	S															
II	34	a horizontal inside corner joint.				S	S	S	S															
II	35	a horizontal tee joint.				S	S	S	S															
II	36	a vertical lap joint.				S	S	S	S															

Figure 24, continued

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Inert gas welding ferrous metals to produce:																						
II	57	a horizontal butt joint.																						
II	58	a horizontal lap joint.				S	S	S	S															
II	59	a horizontal outside corner joint.				S	S	S	S															
II	60	a horizontal inside corner joint.				S	S	S	S															
II	61	a horizontal tee joint.				S	S	S	S															
II	62	a vertical lap joint.				S	S	S	S															
II	63	Inert gas welding pipe stock to produce butt joints while rolling.				S	S	S	S															
II	64	Inert gas welding pipe stock to produce butt joints while fixed.				S	S	S	S															
		Inert gas welding non-ferrous metals to produce:																						
II	65	a horizontal butt joint.				S	S	S	S															
II	66	a horizontal lap joint.				S	S	S	S															
II	67	a horizontal outside corner joint.				S	S	S	S															
II	68	a horizontal inside corner joint.				S	S	S	S															
II	69	a horizontal tee joint.				S	S	S	S															
II	70	a vertical lap joint.				S	S	S	S															
II	71	Butt joints while rolling				S	S	S	S															
II	72	Butt joints while fixed				S	S	S	S															
		SHEET METAL EXPERIENCES																						
I	1	Tracing templates on sheet metal for cutting, bending and joining sheet metal items.																						
I	2	Cutting sheet metal with hand tools to produce a straight cut within 1/32 of an inch.																						
II	3	Cutting sheet metal with machinery to produce a straight cut within 1/32 of an inch.				S	S	S	S															
I	4	Cutting sheet metal with hand tools to produce a circular cut within 1/32 of an inch.	S	S	S	S	S	S	S															
II	5	Cutting sheet metal with machinery to produce a circular cut within 1/32 of an inch.				S	S	S	S															
I	6	Cutting sheet metal with hand tools to produce an irregular cut within 1/32 of an inch.	S	S	S	S	S	S	S															
II	7	Cutting sheet metal with machinery to produce an irregular cut within 1/32 of an inch.				S	S	S	S															
I	8	Cutting sheet metal with hand tools to produce a notched cut within 1/32 of an inch.	S	S	S	S	S	S	S															

Figure 24, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	9	Cutting sheet metal with machinery to produce a notched cut within 1/32 of an inch.				S	S	S	S															
I	10	Cutting sheet metal to produce an interior cut within 1/32 of an inch.	S	S	S	S	S	S	S															
II	11	Forming sheet metal cylindrical shapes on slip roll forming machine.				S	S	S	S															
I	12	Forming sheet metal crimping on a crimping machine.	S	S	S	S	S	S	S															
I	13	Forming sheet metal beading on a beading machine.	S	S	S	S	S	S	S															
II	14	Forming single hem on bar folder or brake for strength.				S	S	S	S															
II	15	Forming double hem on bar folder or brake for strength.				S	S	S	S															
II	16	Forming single seam on a brake and/or bar folder for joining sheet metal parts.				S	S	S	S															
II	17	Forming double seam on a brake and/or bar folder for joining sheet metal parts.				S	S	S	S															
II	18	Forming Pittsburgh lock seam with machinery for joining sheet metal parts.				S	S	S	S															
II	19	Forming cap strip seam on a drive cap machine for joining sheet metal parts.				S	S	S	S															
I	20	Drilling sheet metal to produce a fastener receiver hole.	S	S	S	S	S	S	S															
II	21	Adhering sheet metal parts with adhesives to produce an assembly.				S	S	S	S															
II	22	Welding (spot) sheet metal parts to produce an assembly.				S	S	S	S															
II	23	Soldering sheet metal parts to produce an assembly.				S	S	S	S															
I	24	Fastening sheet metal parts with sheet metal screws to produce an assembly.	S	S	S	S	S	S	S															
I	25	Bolting sheet metal parts to produce an assembly.	S	S	S	S	S	S	S															
II	26	Riveting sheet metal parts to produce an assembly.				S	S	S	S															
I	27	Joining sheet metal parts with seams.	S	S	S	S	S	S	S															
		ASSEMBLY EXPERIENCES																						
I	1	Adhering parts with adhesives using hand processes to produce a metal bonded assembly	S	S	S	S	S	S	S															
II	2	Adhering parts with adhesives using spray equipment to a specified thickness to produce a metal bonded assembly.				S	S	S	S															

Figure 24, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	3	Fastening metal parts with screws to produce an assembly.	S	S	S	S	S	S	S															
I	4	Bolting metal parts with screws to produce an assembly.	S	S	S	S	S	S	S															
I	5	Riveting metal parts to produce an assembly.	S	S	S	S	S	S	S															
I	6	Tightening metal fasteners with hand power tools.	S	S	S	S	S	S	S															
II	7	Mating parts together to produce sub-assemblies.				S	S	S	S															
II	8	Mating parts and sub-assemblies together to produce major assemblies.				S	S	S	S															
I	9	Holding parts in clamping devices for assembly of details, sub-assemblies and assemblies.	S	S	S	S	S	S	S															
II	10	Cutting materials with hand tools to fit in an assembly.				S	S	S	S															
II	11	Cutting materials with power tools to fit in an assembly to 1/32 of an inch.				S	S	S	S															
I	12	Filing stock to produce a finished assembly to .001 of an inch.	S	S	S	S	S	S	S															
I	13	Drilling holes in material with hand drill to produce a hole to .005 of an inch.	S	S	S	S	S	S	S															
I	14	Drilling holes with a hand power drill to produce a hole to .005 of an inch.	S	S	S	S	S	S	S															
II	15	Reaming stock with hand wrench to produce a finished hole to .001 of an inch.				S	S	S	S															
II	16	Reaming stock with power drill to produce a finished hole to .001 of an inch.				S	S	S	S															
I	17	Countersinking holes with hand tools to produce a fastener receiver hole.	S	S	S	S	S	S	S															
I	18	Countersinking holes with power drill to produce a fastener receiver hole.	S	S	S	S	S	S	S															
II	19	Tapping holes with taps to produce a threaded hole.				S	S	S	S															
II	20	Cutting threads with dies to produce a threaded member.				S	S	S	S															
II	21	Punching materials with hand punches to produce a hole.				S	S	S	S															
II	22	Punching materials with power tools to produce an assembly.				S	S	S	S															

Figure 24, continued

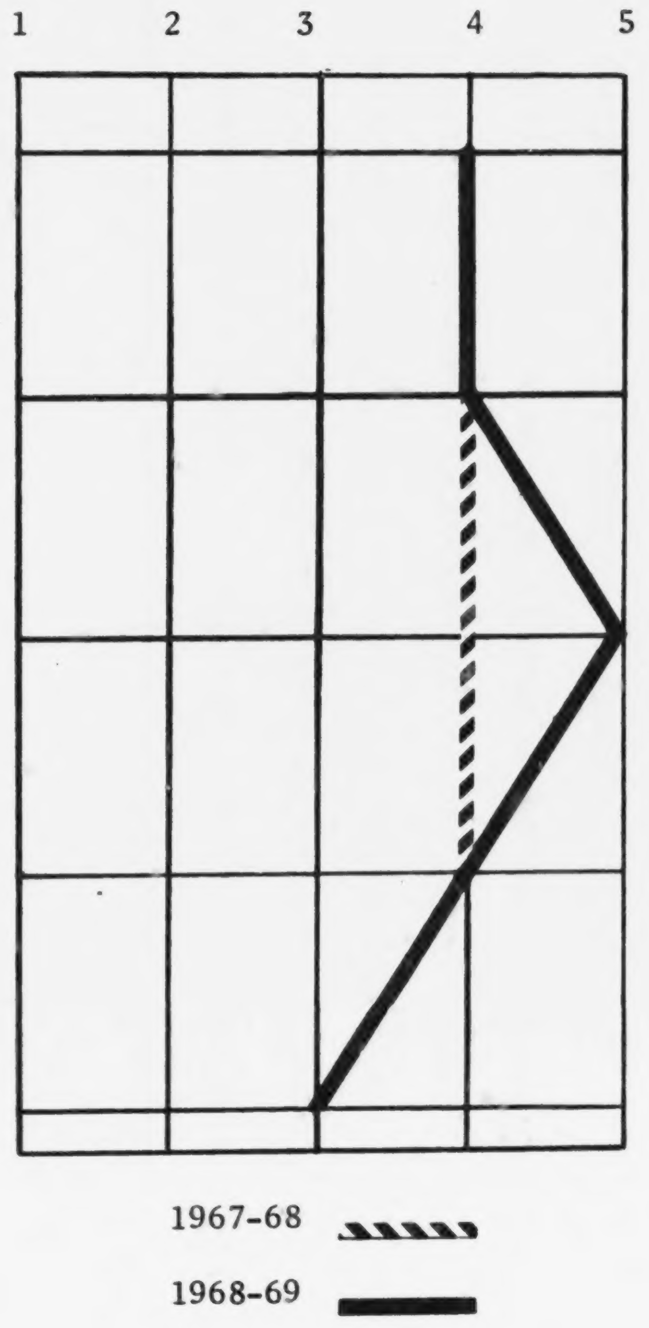
			Student																			
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	23	Checking dimensions of details with precision instruments for accurate assembly.	S	S	S	S	S	S	S															
I	24	Checking dimensions of sub-assemblies and assemblies to produce accurate assemblies.	S	S	S	S	S	S	S															
II	25	Measuring stock with precision instruments for assembly.				S	S	S	S															
I	26	Stamping number and letters on metal stock for identification.	S	S	S	S	S	S	S															
I	27	Removing appropriate metal parts with various hammers.	S	S	S	S	S	S	S															
II	28	Flaring metal tubing with a flaring tool to produce a flare.				S	S	S	S															
III	29	Aligning parts in sub-assemblies and assemblies with hand tools.				S	S	S	S															

Figure 25.

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL D - TEACHER F

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.



Orientation. School J was located in a rural setting. Students in grades 10 through 12 were in attendance. The curriculum options open to students were the college entrance, business, and general curriculums.

The introduction of the metal forming and fabrication cluster into this school marked the first time that a trade and industrial vocational course had been offered. Other practical areas of the curriculum included courses in business, home economics, industrial arts and agriculture.

The administration. The principal of School J supported the cluster program and the teacher. Were it not for his support in authorizing the use of school funds to be spent for material and supplies, there would have been no financial aid for the program in this school whatsoever.

The industrial education supervisor also supported the cluster concept idea and was instrumental in having Teacher J selected as an instructor for the pilot program. Unfortunately, his promotion of the cluster concept was not manifested in any material support in the form of tools, materials, and equipment.

The supervisor was present at most of the visits to School J that were made by the research team.

The teacher. Teacher J had a B.A. degree in Industrial Arts and had done additional graduate work. He had seven years experience in teaching general shop and twenty years experience in teaching metal working. During World War II he conducted a National Defense class in aircraft sheet metal and machine shop practice. His practical work and avocational experiences were also associated with many areas of the metal fomring and fabrication cluster. Teacher J was active in state, county, and local professional teacher associations as an officer and committee member.

Teacher J excelled in teaching, showing a sincere interest in students and a desire to help them grow both technically and socially. It was evident that his students had a great respect for him. He maintained high standards in his class and showed great resourcefulness and initiative in bringing experiences to students which they would not receive in an average learning situation.

Physical facilities. The regular industrial arts laboratory occupied by Teacher J was utilized by the metal forming and fabrication class. The facility was small for the diverse activities called for in the cluster curriculum. However, it had equipment that enabled Teacher J to teach many of the tasks in the cluster. Approximately 50 percent of the tools, materials, and equipment recommended for the cluster were on hand at the beginning of the year. No additional items were received during the course of the two-year pilot program.

A detailed drawing of the laboratory in which the cluster program was conducted is shown in Illustration 8 of the phase III final report. This drawing depicted the major pieces of equipment and set their location in the laboratory. The recommended laboratory facilities as prescribed by the research team are shown in Figure 19.

Instruction. The students gained experiences in all occupations of the cluster, although this experience was somewhat limited due to a lack of tools, materials, and equipment. Students progressed from practice pieces to numerous types of projects, some of a personal nature and several for use within the school. The projects which incorporated tasks from each of the occupations in the cluster included two snow blowers, a rack to hold eight bar bell sets, a utility trailer, and a boat trailer.

Field trips were made to the Pangborn Corporation and Fairchild Corporation in Hagerstown and to the Goddard Space Flight Center in Greenbelt. These visits enabled the students to see many of the most modern industrial processes related with the metal forming and fabrication cluster.

Of the seventeen students who enrolled in the two-year pilot program, fifteen completed the two years of study in the metal forming and fabrication cluster.

In order to evaluate the performance and progress of each student enrolled in the metal forming and fabrication cluster, a task inventory was developed by the research team. This inventory included a list of all the tasks to be taught in the cluster. When kept up-to-date, it provided an objective record of student progress and achievement to the teacher, parents, students, and employers. Evaluation by the teacher provided data on how well each student in the class performed the occupational tasks of the construction cluster. The cognitive abilities were measured by the tests. These are presented in Appendix A. Each student was assigned either a satisfactory (S) or unsatisfactory (U) as an index of his achievement. Those tasks not taught were signified by a blank space in the proper column. See Figure 26.

A second instrument for enabling the gathering and reporting of objective data was developed by the research team. This inventory of student abilities and interests was designed primarily to provide guidance counselors and prospective employers a concise and easily understood evaluation of individual students' abilities, strengths,

Figure 26.

TASK INVENTORY, SCHOOL J

TASK EVALUATION CHART

MACHINING EXPERIENCES

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Turning stock on lathe to produce a faced surface.	S	S	S	S	S	S	S	S	S	S	S	S										
I	2	Countersinking (countersink and center drill) stock to produce a tapered hole for mounting stock between centers.	S	S	S	S	S	S	S	S	S	S	S	S										
I	3	Turning stock on lathe to produce a cyclindrical shape to .001 inch.	S	S	S	S	S	S	S	S	S	S	S	S										
I	4	Turning stock on lathe to produce a shoulder to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S										
I	5	Drilling stock on lathe to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S										
II	6	Reaming stock on lathe to produce a finished hole to .001 of an inch.	S										S	S										
II	7	Boring stock on lathe to produce an enlarged hole to .001 of an inch.	S				S			S		S	S	S										
II	8	Counterboring stock on lathe to produce a recessed hole to .005 of an inch.																						
I	9	Parting stock on lathe to produce a piece within 1/32 of an inch.	S				S	U	S		S		S	S										
II	10	Necking stock on lathe to produce a necked shape to 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S										
I	11	Filing stock on lathe to produce a finished surface.	S	S	S	S	S	S	S	S	S	S	S	S										
I	12	Machining stock on shaper to produce a flat surface.	S	S	S				S					S										
I	13	Machining stock on shaper to produce two parallel surfaces to .005 of an inch.																						
I	14	Drilling stock on drill press to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S										
II	15	Reaming a hole on drill press to produce a finished hole to .001 of an inch.	S						S			S	S	S										
I	16	Spot facing a hole on drill press to produce a finished surface to .005 of an inch.																						
I	17	Countersinking on drill press to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S										
II	18	Counterboring stock on drill press to produce an enlarged hole to .005 of an inch.																						
I	19	Grinding stock on bench grinder to remove excess metal.	S	S	S	S	S	S	S	S	S	S	S	S										
I	20	Grinding drill bits on a bench grinder to sharpen tools.	S	S	S	S	S	S	S	S	S	S	S	S										

Figure 26, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
			Student																					
I	21	Grinding stock on surface grinder to produce a flat surface.																						
I	22	Grinding stock on surface grinder to produce two parallel surfaces to .001 of an inch.																						
II	23	Grinding stock on surface grinder to produce two perpendicular surfaces to .001 of an inch.																						
II	24	Grinding stock on surface grinder to produce an angular surface.																						
I	25	Machining stock on a horizontal milling machine to produce a flat surface.		S	S	S			S															
I	26	Machining stock on a horizontal milling machine to produce parallel surfaces to .001 of an inch.																						
II	27	Machining stock on a horizontal milling machine to produce two perpendicular surfaces to .001 of an inch.		S																				
II	28	Machining stock on a horizontal milling machine to produce a shoulder to .001 of an inch.		S																				
II	29	Machining stock on a horizontal milling machine to produce an angular surface.																						
I	30	Machining stock on a vertical milling machine to produce a flat surface.																						
I	31	Machining stock on a vertical milling machine to produce two parallel surfaces to .001 of an inch.																						
II	32	Machining stock on vertical milling machine to produce two perpendicular surfaces to .001 of an inch.																						
II	33	Machining stock on vertical milling machine to produce a shoulder to .001 of an inch.																						
		WELDING EXPERIENCES																						
		Arc welding ferrous metals with A.C. welder to produce:																						
I	1	a horizontal butt joint.	S	S	S	S	S	S	S	S	S	S	S	S										
I	2	a horizontal lap joint.	S	S	S	S	S	S	S	S	S	S	S	S										
I	3	a horizontal outside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S										
I	4	a horizontal inside corner joint.	S	S	S	S	S	S	S	S	S	S	S	S										
I	5	a horizontal tee joint.	S	S	S	S	S	S	S	S	S	S	S	S										
I	6	a vertical lap joint.																						
II	7	Arc welding pipe stock with A.C. welder to produce a butt joint while fixed.	S	S	S	S	S	S	S	S	S	S	S	S										
II	8	Arc welding pipe stock with A.C. welder to produce butt joints while rolling.	S	S	S	S	S	S	S	S	S	S	S	S										

Figure 26, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Arc welding ferrous metals with D.C. welder to produce																						
I	9	**a horizontal butt joint.**																						
I	10	**a horizontal lap joint.**																						
I	11	**a horizontal outside corner joint.**																						
I	12	**a horizontal inside corner joint.**																						
I	13	**a horizontal tee joint.**																						
I	14	**a vertical lap joint.**																						
II	15	**Arc welding pipe stock with D.C. welder to produce butt joints while fixed.**																						
II	16	**Arc welding pipe stock with D.C. welder to produce butt joints while rolling.**																						
I	17	**Pad welding low areas on metal stock to renew stock to original height.**																						
		Gas welding ferrous metals stock to produce:																						
I	18	**a horizontal butt joint.**	S	S	S	S	S	S	S	S	S	S	S	S										
I	19	**a horizontal lap joint.**	S	S	S	S	S	S	S	S	S	S	S	S										
I	20	**a horizontal outside corner joint.**	S	S	S	S	S	S	S	S	S	S	S	S										
I	21	**a horizontal inside corner joint.**	S	S	S	S	S	S	S	S	S	S	S	S										
I	22	**a horizontal tee joint.**	S	S	S	S	S	S	S	S	S	S	S	S										
I	23	**a vertical lap joint.**																						
I	24	**Gas cutting ferrous carbon steels.**	S	S	S	S	S	S	S	S	S	S	S	S										
		Brazing ferrous metals to produce:																						
I	25	**a horizontal butt joint.**	S	S	S	S	S	S	S	S	S	S	S	S										
I	26	**a horizontal lap joint.**	S	S	S	S	S	S	S	S	S	S	S	S										
I	27	**a horizontal outside corner joint.**	S	S	S	S	S	S	S	S	S	S	S	S										
I	28	**a horizontal inside corner joint.**	S	S	S	S	S	S	S	S	S	S	S	S										
I	29	**a horizontal tee joint.**	S	S	S	S	S	S	S	S	S	S	S	S										
I	30	**a vertical lap joint.**	S	S	S	S	S	S	S	S	S	S	S	S										
		Brazing non-ferrous metals to produce:																						
II	31	a horizontal butt joint.							S															
II	32	a horizontal lap joint.																						
II	33	a horizontal outside corner joint.							S															
II	34	a horizontal inside corner joint.							S															
II	35	a horizontal tee joint.																						
II	36	a vertical lap joint.							S															

Figure 26, continued

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		Inert gas welding ferrous metals to produce:																						
II	37	a horizontal butt joint.																						
II	38	a horizontal lap joint.																						
II	39	a horizontal outside corner joint.																						
II	40	a horizontal inside corner joint.																						
II	41	a horizontal tee joint.																						
II	42	a vertical lap joint.																						
II	43	Inert gas welding pipe stock to produce butt joints while rolling.																						
II	44	Inert gas welding pipe stock to produce butt joints while fixed.																						
		Inert gas welding non-ferrous metals to produce:																						
II	45	a horizontal butt joint.																						
II	46	a horizontal lap joint.																						
II	47	a horizontal outside corner joint.																						
II	48	a horizontal inside corner joint.																						
II	49	a horizontal tee joint.																						
II	50	a vertical lap joint.																						
II	51	butt joints while rolling																						
II	52	butt joints while fixed																						
		SHEET METAL EXPERIENCES																						
I	1	Tracing templates on sheet metal for cutting, bending and joining sheet metal items.	S	S	S	S	S	S	S	S	S	S	S	S										
I	2	Cutting sheet metal with hand tools to produce a straight cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S										
II	3	Cutting sheet metal with machinery to produce a straight cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S										
I	4	Cutting sheet metal with hand tools to produce a circular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S										
II	5	Cutting sheet metal with machinery to produce a circular cut within 1/32 of an inch.																						
I	6	Cutting sheet metal with hand tools to produce an irregular cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S										
II	7	Cutting sheet metal with machinery to produce an irregular cut within 1/32 of an inch.																						
I	8	Cutting sheet metal with hand tools to produce a notched cut within 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S										

Figure 26, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	9	Cutting sheet metal with machinery to produce a notched cut within 1/32 of an inch.																						
I	10	Cutting sheet metal to produce an interior cut within 1/32 of an inch.																						
II	11	Forming sheet metal cylindrical shapes on slip roll forming machine.	S	S	S	S	S	S	S	S	S	S	S	S										
I	12	Forming sheet metal crimping on a crimping machine.																						
I	13	Forming sheet metal beading on a beading machine.																						
II	14	Forming single hem on bar folder or brake for strength.	S	S	S	S	S	S	S	S	S	S	S	S										
II	15	Forming double hem on bar folder or brake for strength.	S	S	S	S	S	S	S	S	S	S	S	S										
II	16	Forming single seam on a brake and/or bar folder for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S										
II	17	Forming double seam on a brake and/or bar folder for joining sheet metal parts.	S	S	S	S	S	S	S	S	S	S	S	S										
II	18	Forming Pittsburgh lock seam with machinery for joining sheet metal parts.																						
II	19	Forming cap strip seam on a drive cap machine for joining sheet metal parts.																						
I	20	Drilling sheet metal to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S										
II	21	Adhering sheet metal parts with adhesives to produce an assembly.																						
II	22	Welding (spot) sheet metal parts to produce an assembly.																						
II	23	Soldering sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S										
I	24	Fastening sheet metal parts with sheet metal screws to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S										
[illegible]	25	Bolting sheet metal parts to produce an assembly.																						
II	26	Riveting sheet metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S										
[illegible]	27	Joining sheet metal parts with seams.	S	S	S	S	S	S	S	S	S	S	S	S										
		ASSEMBLY EXPERIENCES																						
[illegible]	1	Adhering parts with adhesives using hand processes to produce a metal bonded assembly																						
II	2	Adhering parts with adhesives using spray equipment to a specified thickness to produce a metal bonded assembly.																						

Figure 26, continued

Level	Task No.	Task Statement	Student																				
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	3	Fastening metal parts with screws to produce an assembly.																						
I	4	Bolting metal parts with screws to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S										
I	5	Riveting metal parts to produce an assembly.	S	S	S	S	S	S	S	S	S	S	S	S										
I	6	Tightening metal fasteners with hand power tools.																						
II	7	Mating parts together to produce sub-assemblies.	S	S	S	S	S	S	S	S	S	S	S	S										
II	8	Mating parts and sub-assemblies together to produce major assemblies.	S	S	S	S	S	S	S	S	S	S	S	S										
I	9	Holding parts in clamping devices for assembly of details, sub-assemblies and assemblies.	S	S	S	S	S	S	S	S	S	S	S	S										
II	10	Cutting materials with hand tools to fit in an assembly.	S	S	S	S	S	S	S	S	S	S	S	S										
II	11	Cutting materials with power tools to fit in an assembly to 1/32 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S										
I	12	Filing stock to produce a finished assembly to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S										
I	13	Drilling holes in material with hand drill to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S										
I	14	Drilling holes with a hand power drill to produce a hole to .005 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S										
II	15	Reaming stock with hand wrench to produce a finished hole to .001 of an inch.																						
II	16	Reaming stock with power drill to produce a finished hole to .001 of an inch.	S	S	S	S	S	S	S	S	S	S	S	S										
I	17	Countersinking holes with hand tools to produce a fastener receiver hole.																						
I	18	Countersinking holes with power drill to produce a fastener receiver hole.	S	S	S	S	S	S	S	S	S	S	S	S										
II	19	Tapping holes with taps to produce a threaded hole.	S	S	S	S	S	S	S	S	S	S	S	S										
II	20	Cutting threads with dies to produce a threaded member.	S	S	S	S	S	S	S	S	S	S	S	S										
II	21	Punching materials with hand punches to produce a hole.	S	S	S	S	S	S	S	S	S	S	S	S										
II	22	Punching materials with power tools to produce an assembly.																						

Figure 26, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	23	Checking dimensions of details with precision instruments for accurate assembly.	S	S	S	S	S	S	S	S	S	S	S	S										
I	24	Checking dimensions of sub-assemblies and assemblies to produce accurate assemblies.	S	S	S	S	S	S	S	S	S	S	S	S										
II	25	Measuring stock with precision instruments for assembly.	S	S	S	S	S	S	S	S	S	S	S	S										
I	26	Stamping number and letters on metal stock for identification.	S	S	S	S	S	S	S	S	S	S	S	S										
I	27	Hammering appropriate metal parts with various hammers.	S	S	S	S	S	S	S	S	S	S	S	S										
II	28	Flaring metal tubing with a flaring tool to produce a flare.																						
II	29	Aligning parts in sub-assemblies and assemblies with hand tools.																						

and interests. Included in this instrument were data relevant to interests as reflected by the Minnesota Vocational Interest Inventory, and summary ratings on the task performances indicated by superior, average, or below average. Evaluations of student skills and knowledges in the occupational areas of the cluster program were also summarized. A sample student abilities and interests inventory is presented in Appendix B.

Community involvement. Through field trips, Teacher J made some useful contacts with industries in the area. One company furnished the class with a supply of stock for welding practice and another offered some good employment possibilities. The students were encouraged by representatives of various industrial concerns in the community.

As a result of students making contributions to the community in the form of maintenance and repair, the class received recognition and praise from individuals in the community.

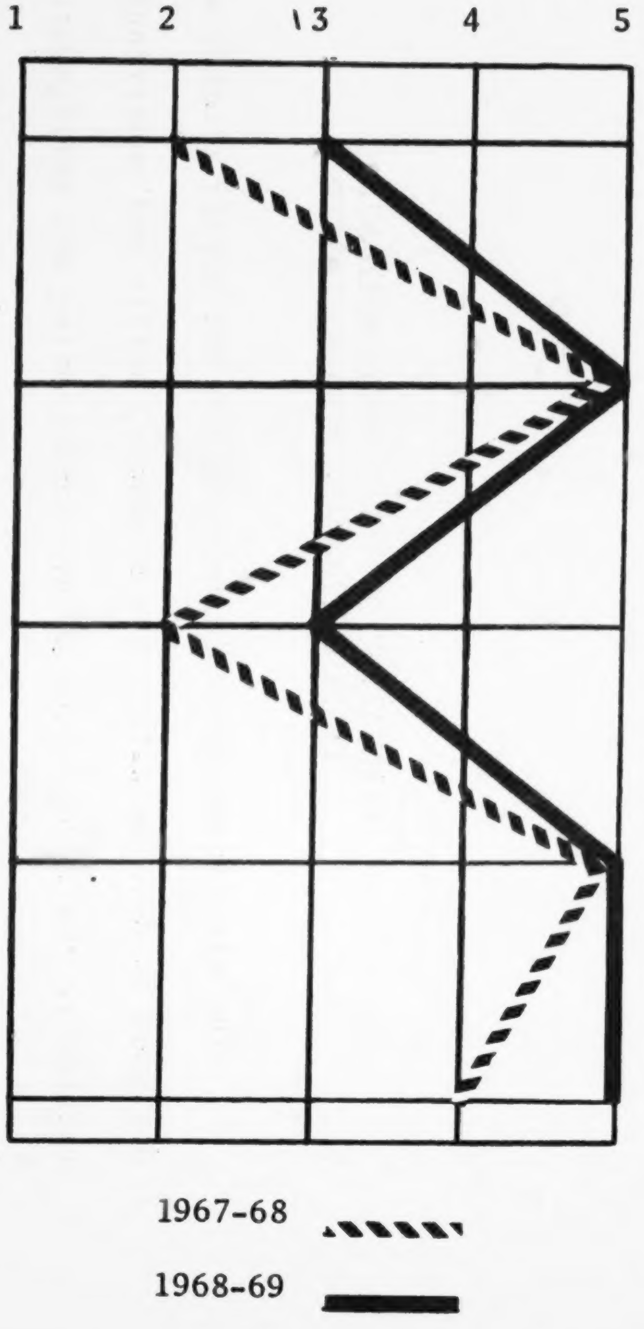
A visual summary synthesizing the evaluation of the five areas (administration, teacher, physical facilities, instruction, and community involvement) which have been featured in the description of the pilot program at School J is presented in Figure 27.

Figure 27.

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL J

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.



EVALUATION OF THE ELECTRO-MECHANICAL INSTALLATION AND REPAIR CLUSTER

The electro-mechanical installation and repair cluster was designed to develop within the students, skills and understandings related to the occupations of air conditioning and refrigeration servicemen , business machine servicemen, home appliance servicemen, and radio and television servicemen. The cluster program is not designed for in-depth development of skills in any one occupation, but aims at preparing students to enter into any of the occupations within the electro-mechanical installation and repair cluster.

The following objectives served as goals for the electro-mechancial installation and repair cluster:

1. To broaden the student's understanding of the available opportunities in occupations within the parameters of the electro-mechanical installation and repair cluster.
2. To develop job entry skills and knowledge for all of the identified occupations found in the electro-mechanical installation and repair cluster.
3. To develop a favorable attitude toward work activities and problems of the electro-mechanical installation and repair cluster.
4. To develop a student's understanding of the sources of information that will be helpful to him as he moves through the occupational areas.

The specific objectives for the course are the following:

1. To develop the student's competency in the use of necessary hand tools found in the electro-mechanical installation and repair cluster.
2. To develop the student's competency in using instruments, power tools, and equipment needed for job entry into the occupations found in the electro-mechanical installation and repair cluster.
3. To develop the student's understanding of the operations, procedures, and processes associated with the electro-mechanical installation and repair cluster.
4. To develop safe working habits related to the occupations within the electro-mechanical installation and repair cluster.
5. To familiarize the student with the terminology associated with the electro-mechanical installation and repair cluster.
6. To develop an understanding of the resources available to him in his pursuit of the course as well as in his work following graduation.

Plan of Presentation

In the following section of the report the pilot program of each school will be discussed with reference to the administration, the teacher, the physical facilities, the instruction, and community involvement.

The information reported was obtained by members of the cluster concept project research team through a series of bi-weekly visitations to the various schools that conducted pilot programs in the electro-mechanical installation and repair cluster.

Orientation. School G was located in an urban setting, although some of the students were from outlying areas. Students in grades 10 through 12 were in attendance. The students could select either the college entrance, business, agriculture, vocational, or general curriculum.

The introduction of the electro-mechanical installation and repair cluster into this school extended the offerings of the practical arts curriculum. In addition to the electro-mechanical cluster, the other practical areas of the curriculum included business (distributive education), home economics, industrial arts, automotives, and agriculture.

The administration. Both the principal and vice-principal gave consistent support to the cluster concept program and to the teacher in charge of the program at School G. The administration, including the guidance counselor, was extremely helpful with problems involving scheduling students and class time, and with student recruitment, enrollment, and placement.

The supervisor of industrial education accompanied the research team on visitations to the schools in his county involved in the cluster program. This supervisor gave continuous encouragement and support to the cluster teachers and their programs.

The teacher. Teacher G had a B.S. degree in Industrial Arts and a M.Ed. degree in Vocational Education. His teaching experience covered eight years in the area of industrial education with seven of those years dealing with the teaching of electricity and electronics.

Teacher G was a very resourceful person. He showed great initiative in the procurement of free or inexpensive equipment and materials for instructional purposes. This material and equipment was obtained from local industries and businesses and from other schools which had a surplus of certain instructional items.

Physical facilities. At the beginning of the 1967-1968 school term, none of the recommended supplies and equipment was available. During that term only about 10 percent of the tools, materials, and equipment recommended for this program was received. Teacher G conducted his program by utilizing equipment and materials which had been donated by private individuals and business organizations. As a result of the lack of necessary tools, materials, and equipment , only partial instruction was offered in the occupational areas of this cluster.

During the school year, 1968-1969, the program at School G received an additional 60 percent of the recommended tools, materials, and equipment. The acquisition of these items stemmed primarily from a group effort involving the teacher, supervisor, and research team. An inventory of the instructional supplies recommended for the electro-mechanical installation and repair cluster at School G is presented in Appendix C.

A detailed drawing of the laboratory in which the electro-mechanical installation and repair cluster was taught at School G was presented in the final report of phase III. The recommended facilities are shown in Figure 28.

Instruction. Learning experiences were provided in the servicing of air-conditioning and refrigeration units, business and office machines, home appliances, and radio and television. This instruction involved the supplementation of the theory associated with these areas with as much practical experience as possible.

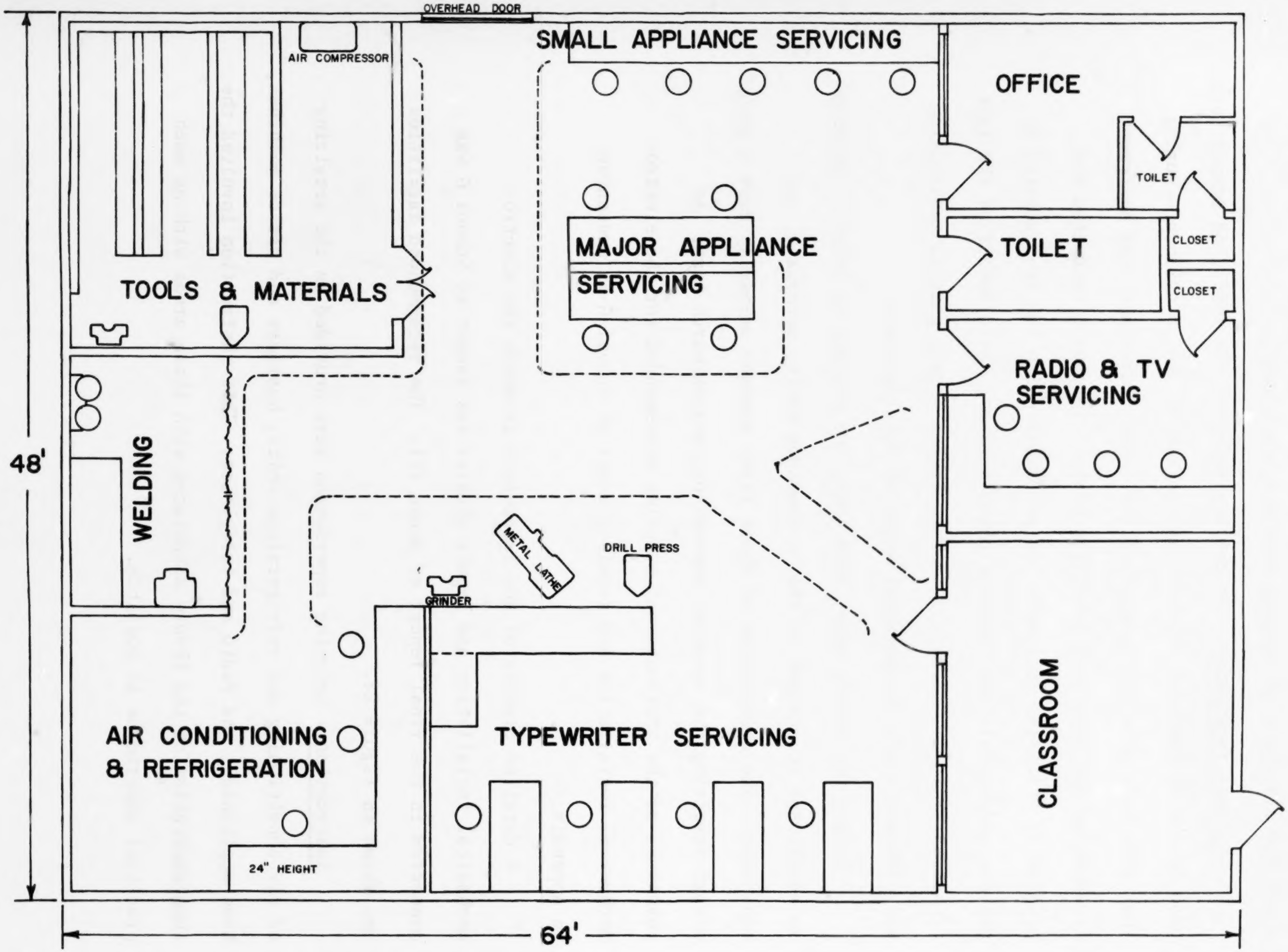
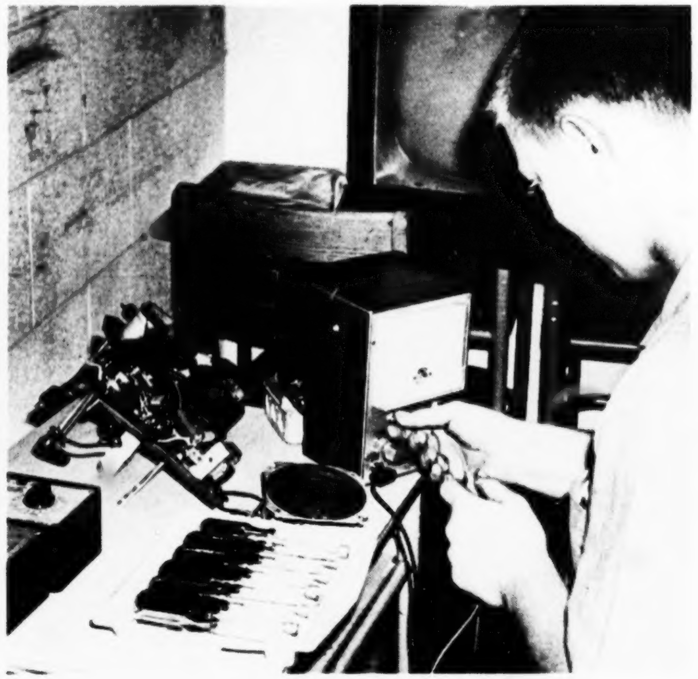
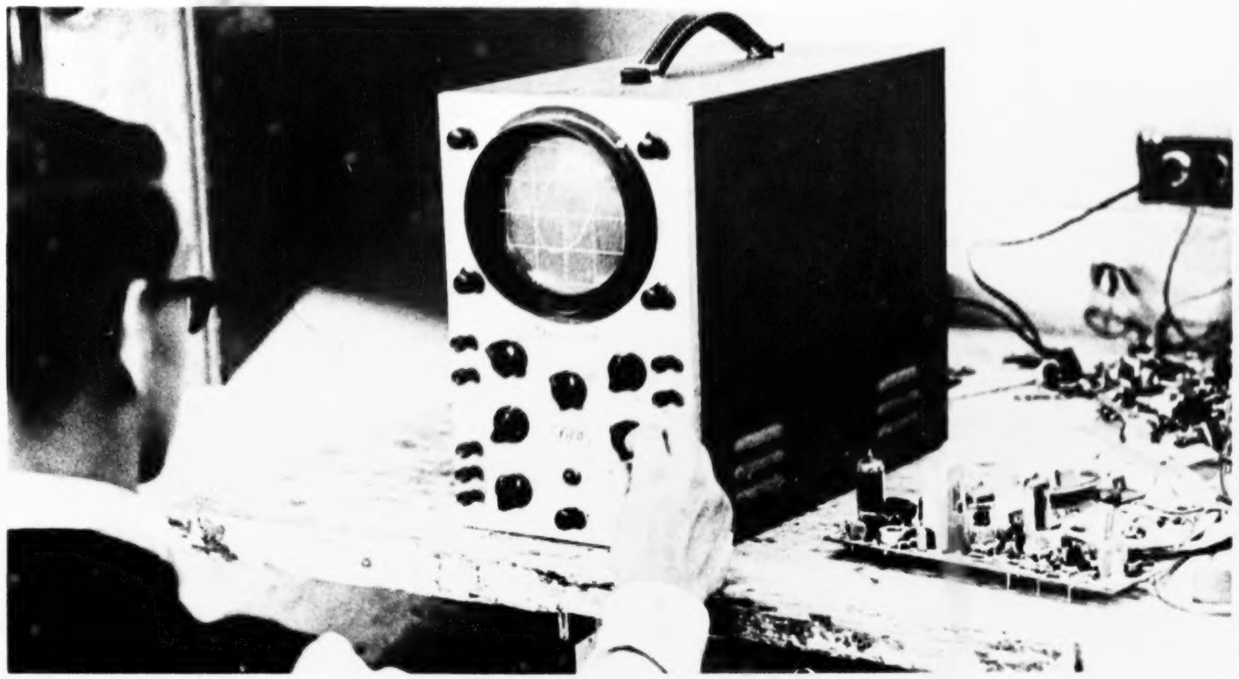


Figure 28. Suggested Floor Plan
Electro-Mechanical Installation and Repair Cluster

ELECTRO-MECHANICAL CLUSTER ACTIVITIES





Examples of the kinds of learning experiences provided at School G are as follows: construction of a parabolic reflector to be used to augment the sound system on the athletic field, servicing and repairing toasters, flat irons, timing lights, radios, record players, televisions, typewriters, refrigerators, freezers, air conditioners, washing machines, electric ranges, and outside television antennae.

Although the teacher provided adequate learning experiences in each occupational area of the electro-mechanical installation and repair cluster, more experiences were provided in some areas than others. This inequity was a reflection of the limitations placed on the cluster program at School G due to the inability to secure the total amount of the recommended tools, materials, and equipment.

Four of the original six students completed the two-year electro-mechanical installation and repair cluster curriculum at School G. These students were taught along with a second group of fifteen first year cluster students. In the opinion of the teacher, this unusual grouping resulted in greater student achievement. It should be noted that the results discussed in other parts of this report deal with only those four students who started and completed the two years of study in the cluster curriculum.

In order to evaluate the performance and progress of each student enrolled in the electro-mechanical installation and repair cluster, a task inventory was developed by the research team. This inventory included a list of all the tasks to be taught in the cluster. When kept up-to-date, it provided an objective record of student progress and achievement to the teacher, parents, students, and employers. Evaluation by the teacher provided data on how well each student in the class performed the occupational tasks of the construction cluster. The cognitive abilities were measured by the tests. These are provided in Appendix A. Each student was assigned either a satisfactory (S) or unsatisfactory (U) as an index of his achievement. Those tasks not taught were signified by a blank space. See Figure 29.

A second instrument for enabling the gathering and reporting of objective data was developed by the research team. This inventory of student abilities and interests was designed primarily to provide guidance counselors and prospective employers a concise and easily understood evaluation of individual students' strengths, abilities, and interests. Included in this instrument were data relevant to interests as reflected by the Minnesota Vocational Interest Inventory, and summary ratings on the task performances indicated by superior, average, or below average. Evaluations of student skills and knowledges in the occupational areas of the cluster program were also summarized. A sample student abilities and interest inventory is presented in Appendix B.

Community involvement. Community involvement in this program was more than adequate. Through the combined efforts of Teacher G and his cluster students, various items of instructional value were obtained from private individuals and members of the business community.

In undertaking their work during the year, the class took field trips to industrial plants and small repair shops where much of the electro-mechancial work performed paralleled the tasks outlined in the cluster concept curriculum. Individuals representing some of these firms also served as resource persons and guest lecturers and demonstrators for the class.

Figure 29.

TASK INVENTORY, SCHOOL G

TASK EVALUATION CHART

AIR CONDITIONING & REFRIGERATION SERVICING EXPERIENCES

Student

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	1	Installing tubing between case and condensing unit.	S	S	S	S																		
I	2	Testing lines with detection device for leaks	S	S	S	S																		
II	3	Installing gages on condensing unit to charge the unit with refrigerant.	S	S	S	S																		
I	4	Evacuating the entire system with a vacuum pump to remove all non-condensibles.	S	S	S	S																		
I	5	Removing the cover from the unit for ease of servicing.	S	S	S	S																		
II	6	Replacing the defective components in the refrigeration unit.	S	S	S	S																		
I	7	Replacing the cover on the unit to restore to the original condition.	S	S	S	S																		
		BUSINESS MACHINE SERVICING EXPERIENCES																						
II	1	Observing the symptoms to determine the defects in a typewriter.	S	S	S	S																		
I	2	Disassembling the typewriter for cleaning.	S	S	S	S																		
I	3	Cleaning typewriter to remove dirt.	S	S	S	S																		
II	4	Isolating the mechanical defects to a particular section of the typewriter.	S	S	S	S																		
II	5	Isolating the electrical defect(s) to a particular component of the typewriter.																						
II	6	Isolating the mechanical defect(s) to a particular component of the typewriter.	S	S	S	S																		
I	7	Removing the defective part(s) of the typewriter.	S	S	S	S																		
II	8	Replacing the defective part(s) of the typewriter.	S	S	S	S																		
II	9	Reassembling the repaired typewriter.	S	S	S	S																		
II	10	Testing the operation of the repaired typewriter.	S	S	S	S																		

Figure 29, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	11	Disassembling the calculator for cleaning.																						
I	12	Cleaning the calculator to remove dirt.																						
II	13	Removing the defective part(s) of the calculator.																						
II	14	Replacing the defective part(s) of the calculator.																						
II	15	Reassembling the repaired calculator.																						
II	16	Testing the operation of the repaired calculator.																						
I	17	Disassembling the adding machine for cleaning.																						
I	18	Cleaning the adding machine to remove dirt.																						
II	19	Removing the defective part(s) of the adding machine.																						
II	20	Replacing the defective part(s) of the adding machine.																						
II	21	Reassembling the repaired adding machine.																						
II	22	Testing the operation of the repaired adding machine.																						
		HOME APPLIANCE SERVICING EXPERIENCES																						
I	1	Observing the symptoms to determine the defect(s) in small heating element appliances.	S	S	S	S																		
I	2	Disassembling small heating element appliances for testing and repairing.	S	S	S	S																		
I	3	Isolating the defect to a particular section of the heating element appliance.	S	S	S	S																		
I	4	Isolating the defect to a particular component of the heating element appliance.	S	S	S	S																		
I	5	Replacing the defective part(s) of small heating element appliances.	S	S	S	S																		
I	6	Testing the operations of the repaired small heating element appliance.	S	S	S	S																		
I	7	Reassembling the repaired small heating element appliance.	S	S	S	S																		
I	8	Retesting the assembled small heating element appliance.	S	S	S	S																		
I	9	Observing the symptoms to determine the defect(s) in small motor driven appliances.	S	S	S	S																		
I	10	Disassembling small electric motor appliances for testing and repairing.	S	S	S	S																		

Student

Figure 29, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
			Student																					
I	11	Isolating the mechanical defect(s) to a particular section of the small electric motor appliances.	S	S	S	S																		
I	12	Isolating the electrical defect(s) to a particular section of the small electric motor appliances.	S	S	S	S																		
I	13	Isolating the defect to a particular component of the small electric motor appliance.	S	S	S	S																		
I	14	Replacing the defective part(s) of the small electric motor appliances.	S	S	S	S																		
I	15	Testing the operation of the repaired small electric motor appliances.	S	S	S	S																		
I	16	Reassembling the repaired small electric motor appliance.	S	S	S	S																		
I	17	Retesting the repaired small electric motor appliances.	S	S	S	S																		
I	18	Connecting the electrical supply to the electric range in the home.																						
I	19	Checking the installation of the electric range and making any final adjustments necessary.																						
I	20	Explaining the operation of the electric range to the customer.																						
I	21	Installing the vent system for the automatic dryer in the home.																						
I	22	Connecting the electrical supply to the automatic dryer in the home.																						
I	23	Testing the installation of the automatic dryer and making any final adjustments necessary.																						
I	24	Explaining the operation of the automatic dryer to the customer.																						
I	25	Connecting the water supply to the automatic washer in the home.																						
I	26	Connecting the electrical supply to the automatic washer in the home.																						
I	27	Checking the installation of the automatic washer and making any final adjustments necessary.																						
I	28	Explaining the operation of the automatic washer to the customer.																						
I	29	Connecting the electrical supply to the refrigerator in the home.																						
I	30	Checking the installation of the refrigerator and making any final adjustments necessary.																						

Figure 29, continued

Level	Task No.	Task Statement	Student A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	31	Explaining the operation of the refrigerator to the customer.																						
I	32	Observing the symptoms to determine the defect(s) in an automatic washer.																						
I	33	Disassembling the automatic washer in order to make the necessary repair(s).	S	S	S	S																		
II	34	Isolating the electrical defect(s) to a particular section of the automatic washer.	S	S	S	S																		
II	35	Isolating the mechanical defect(s) to a particular section of the automatic washer.																						
II	36	Isolating the defect(s) to a particular component in an automatic washer.	S	S	S	S																		
I	37	Replacing the defective part(s) of the automatic washer.	S	S	S	S																		
II	38	Repairing the defective part(s) of the automatic washer.	S	S	S	S																		
II	39	Reassembling the repaired automatic washer.	S	S	S	S																		
II	40	Testing the operation of the automatic washer.	S	S	S	S																		
II	41	Making any final adjustments to the repaired automatic washer.	S	S	S	S																		
I	42	Retesting the assembled automatic washer.	S	S	S	S																		
II	43	Observing the symptoms to determine the defect(s) in an automatic electric dryer.																						
II	44	Isolating the electrical defect(s) to a particular section of the automatic electric dryer. .																						
II	45	Isolating the mechanical defect(s) to a particular section of the automatic electrical dryer.																						
I	46	Disassembling the automatic electric dryer in order to make the necessary repair(s).																						
II	47	Isolating the defect(s) to a particular component in an automatic electric dryer.																						
I	48	Replacing the defective part(s) of the automatic electric dryer.																						
II	49	Repairing the defective part(s) of the automatic electric dryer.																						
II	50	Reassembling the repaired automatic electric dryer.																						

Figure 29, continued

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	51	Testing the operation of the automatic electric dryer.																						
I	52	Making any final adjustments to the repaired automatic electric dryer.																						
I	53	Retesting the assembled automatic electric dryer.																						
II	54	Observing the symptoms to determine the defect(s) in a refrigerator.	S	S	S	S																		
I	55	Disassembling the refrigerator in order to make the necessary repair(s).	S	S	S	S																		
II	56	Isolating the electrical defect(s) to a particular section of the refrigerator.	S	S	S	S																		
II	57	Isolating the mechanical defect(s) to a particular section of the refrigerator.	S	S	S	S																		
II	58	Isolating the defect(s) to a particular component in a refrigerator.	S	S	S	S																		
I	59	Replacing the defective part(s) of the refrigerator.	S	S	S	S																		
II	60	Repairing the defective part(s) of the refrigerator.	S	S	S	S																		
II	61	Reassembling the repaired refrigerator.	S	S	S	S																		
I	62	Testing the operation of the refrigerator.	S	S	S	S																		
I	63	Making any final adjustments to the repaired refrigerator.	S	S	S	S																		
I	64	Retesting the assembled refrigerator.	S	S	S	S																		
II	65	Observing the symptoms to determine the defect(s) in an electric range.	S	S	S	S																		
II	66	Isolating the electrical defect(s) to a particular section of the electric range.	S	S	S	S																		
I	67	Disassembling the electric range in order to make the necessary repair(s).	S	S	S	S																		
II	68	Isolating the mechanical defect(s) to a particular section of the electric range.	S	S	S	S																		
II	69	Isolating the defect(s) to a particular component in an electric range.	S	S	S	S																		
I	70	Replacing the defective part(s) of the electric range.	S	S	S	S																		
II	71	Repairing the defective part(s) of the electric range.	S	S	S	S																		
I	72	Reassembling the repaired electric range.	S	S	S	S																		
I	73	Testing the operation of the electric range.	S	S	S	S																		
I	74	Making any final adjustments to the repaired electric range.	S	S	S	S																		
I	75	Retesting the assembled electric range.	S	S	S	S																		

Figure 29, continued

RADIO AND TELEVISION SERVICING EXPERIENCES

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Observing the symptoms to determine the defective stage of the radio.			S	S																		
I	2	Checking the tubes in the suspected defective stage of the radio.	S	S	S	S																		
I	3	Removing the chassis from the cabinet for ease of servicing.	S	S	S	S																		
II	4	Isolating the defective components in a particular stage of the radio.			S	S																		
I	5	Replacing the defective components in a particular stage of the radio.	S	S	S	S																		
I	6	Replacing the chassis in the cabinet after final inspection of the radio.	S	S	S	S																		
I	7	Making final operational checks and adjustment to the radio.			S	S																		
I	8	Observing the symptoms to determine the defective stage of the television set.			S	S																		
I	9	Checking the tubes in the suspected stage.	S	S	S	S																		
I	10	Removing the chassis from the cabinet for ease of servicing.	S	S	S	S																		
II	11	Isolating the defective components in a particular stage of the television set.			S	S																		
I	12	Replacing the defective components in a particular stage of the television set.			S	S																		
I	13	Replacing the chassis in the cabinet after final inspection of the television set.	S	S	S	S																		
I	14	Making final operational checks and adjustment to the television set.			S	S																		
II	15	Installing an outdoor television's antenna and transmission line.																						

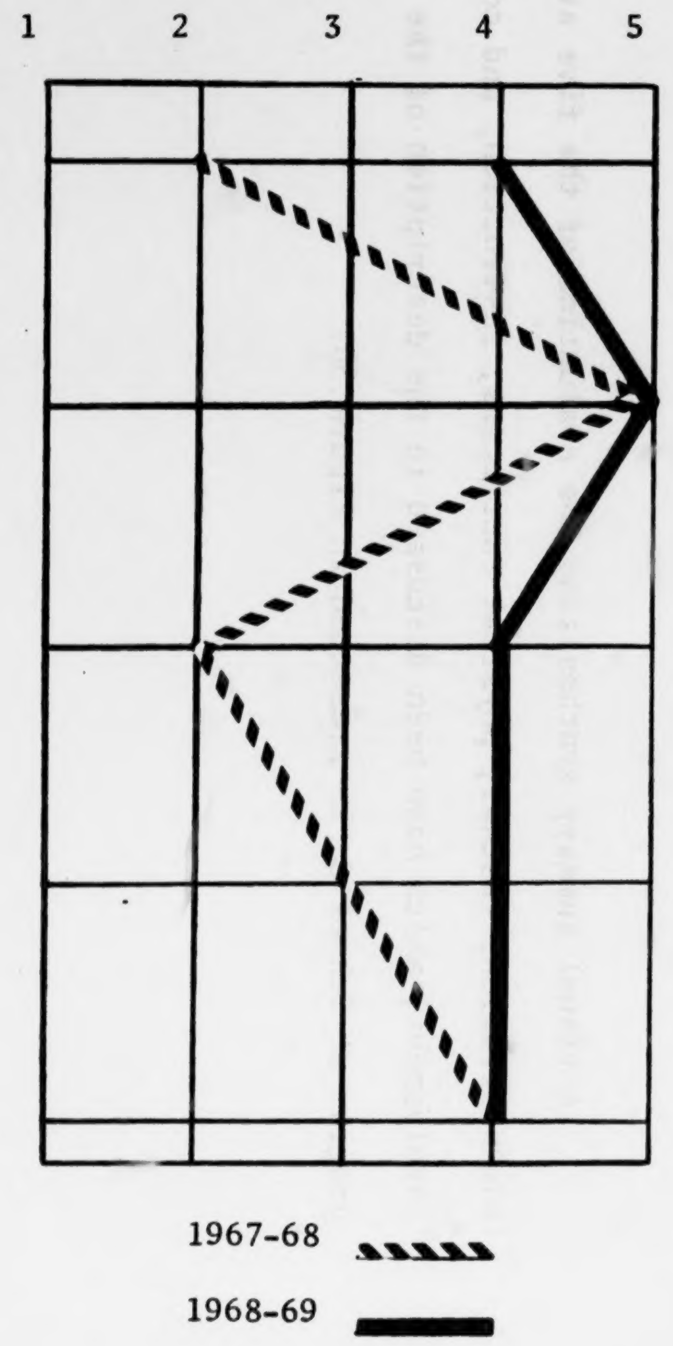
A visual summary synthesizing the evaluation of the five areas (administration, teacher, physical facilities, instruction, and community involvement) which have been discussed in the description of the pilot program at School G, is presented in Figure 30.

Figure 30.

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL G

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.



Orientation. School M was located in an urban setting and was composed of grades 10 through 12. The students could select either the college entrance, business (distributive and commercial education), vocational, or general curriculum.

The introduction of the electro-mechanical installation and repair cluster into this school extended the offerings of the practical arts curriculum. In addition to the cluster program, the other areas of the school curriculum included courses in commercial and distributive education, home economics, industrial arts, carpentry, plumbing and heating, air conditioning and refrigeration, graphic arts, building maintenance, masonry, and cosmetology.

The administration. The administration at School M, while favoring the idea of the cluster concept program, provided only minimal support and encouragement throughout the two years of the pilot program. The teacher was given a planning period during the second year of the program. This was the major change in the support coming from the administration.

The county supervisor, unfortunately, was unable to meet with the teacher and research team during the scheduled visitations at School M. However, he attended the planning conference and participated to a great measure. He did support the program in terms of providing the necessary tools, equipment, and materials for implementing the electro-mechanical installation and repair cluster curriculum at School M.

The teacher. Teacher M's preparation for teaching consisted of a high school diploma and college credits towards certification to teach vocational subjects at the high school level. He had one year of teaching experience in various areas related to the electro-mechanical installation and repair cluster. He had several years of experience as a tradesman but in an occupational area not related to the elctro-mechanical installation and repair cluster.

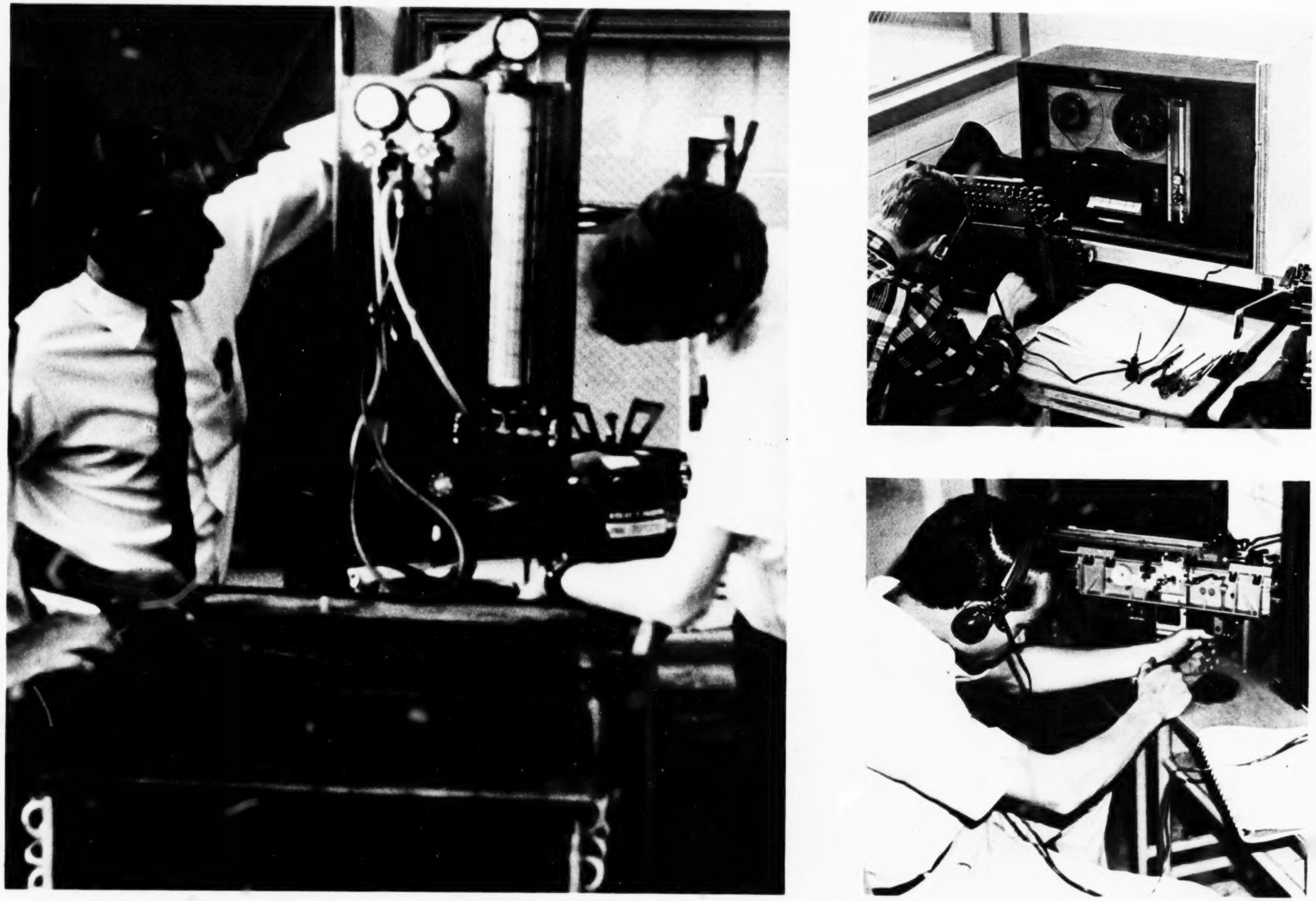
Physical facilities. During the two-year period of the cluster concept pilot program at School M, approximately 90 percent of the tools, materials, and equipment recommended by the cluster concept project research team as essential to conduct an effective program was received.

In order to facilitate instruction in the area of typewriter repair, a section of the laboratory designated as a finishing room was converted into an independent classroom for instruction in typewriter repair. Six individual booths (carrels) were constructed, each equipped with a tape recorder, typewriter, and the necessary tools. Thus, each student was able to progress independently at his own rate. This school was the only one of the two electro-mechanical installation and repair cluster schools to have such a facility.

A detailed drawing of the laboratory in which the cluster program was conducted was presented in phase III. This drawing also depicted major pieces of equipment and their location in the laboratory. The recommended laboratory facilities as specified by the research team are shown in Figure 28.

Instruction. Of the original nine students who were enrolled in the two-year pilot program at School M, seven completed the program. The teacher at School M was able to utilize the facilities and equipment of the other vocational areas to supplement the cluster concept program. It should be noted that the teacher at School M did not take full advantage of the resources made available to him. As a result, the students in the electro-mechanical cluster at School M received most of their instruction in the occupational areas of air conditioning and

ELECTRO-MECHANICAL CLUSTER ACTIVITIES



refrigeration and typewriter repair. Experiences in the other occupational areas for this cluster were limited. Experiences in the repair of refrigerators were incorporated with instruction of air conditioning and refrigeration. A limited amount of instruction was given in the areas of large and small appliances, while in the areas of radio and television repair, it was limited to very basic tasks performed on surplus equipment, most of which was beyond repair prior to the beginning of instruction.

In order to evaluate the performance and progress of each student enrolled in the electro-mechanical installation and repair cluster, a task inventory was developed by the research team. This inventory included a list of all the tasks to be taught in the cluster. When kept up-to-date, it provided an objective record of student progress and achievement to the teacher, parents, students, and employers. Evaluation by the teacher provided data on how well each student in the class performed the occupational tasks of the construction cluster. The cognitive abilities were measured by the tests. These are provided in Appendix A. Each student was assigned either a satisfactory (S) or unsatisfactory (U) as an index of his achievement. Those tasks not were signified by a blank space on the chart. See Figure 31.

A second instrument for enabling the gathering and reporting of objective data was developed by the research team. This inventory of student abilities and interests was designed primarily to provide guidance counselors and prospective employers a concise and easily understood evaluation of individual students' strengths, abilities, and interests. Included in this instrument were data relevant to interests as reflected by the Minnesota Vocational Interest Inventory, and summary ratings on the task performances indicated by superior,

Figure 31.

TASK INVENTORY, SCHOOL M

TASK EVALUATION CHART

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
		AIR CONDITIONING & REFRIGERATION SERVICING EXPERIENCES																						
II	1	Installing tubing between case and condensing unit.	S	S	U	S	S	U	S															
I	2	Testing lines with detection device for leaks	S	S	S	S	S	S	S															
II	3	Installing gages on condensing unit to charge the unit with refrigerant.	S	S	S	S	S	S	S															
I	4	Evacuating the entire system with a vacuum pump to remove all non-condensibles.	S	S	U	S	S	U	S															
I	5	Removing the cover from the unit for ease of servicing.	S	S	S	S	S	S	S															
II	6	Replacing the defective components in the refrigeration unit.																						
I	7	Replacing the cover on the unit to restore to the original condition.	S	S	S	S	S	S	S															
		BUSINESS MACHINE SERVICING EXPERIENCES																						
II	1	Observing the symptoms to determine the defects in a typewriter.	S	S	U	S	S	U	S															
I	2	Disassembling the typewriter for cleaning.	U	S	U	U	S	U	S															
I	3	Cleaning typewriter to remove dirt.	S	S	S	S	S	S	S															
II	4	Isolating the mechanical defects to a particular section of the typewriter.	U	S	U	U	S	U	S															
II	5	Isolating the electrical defect(s) to a particular component of the typewriter.																						
II	6	Isolating the mechanical defect(s) to a particular component of the typewriter.	U	S	U	U	S	U	S															
I	7	Removing the defective part(s) of the typewriter.	U	S	U	U	S	U	S															
II	8	Replacing the defective part(s) of the typewriter.	U	S	U	U	S	U	S															
II	9	Reassembling the repaired typewriter.	U	S	U	U	S	U	S															
II	[illegible]	Testing the operation of the repaired typewriter.	U	S	U	U	S	U	S															

Figure 31, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
II	11	Disassembling the calculator for cleaning.																						
I	12	Cleaning the calculator to remove dirt.																						
II	13	Removing the defective part(s) of the calculator.																						
II	14	Replacing the defective part(s) of the calculator.																						
II	15	Reassembling the repaired calculator.																						
II	16	Testing the operation of the repaired calculator.																						
I	17	Disassembling the adding machine for cleaning.																						
I	18	Cleaning the adding machine to remove dirt.																						
II	19	Removing the defective part(s) of the adding machine.																						
II	20	Replacing the defective part(s) of the adding machine.																						
II	21	Reassembling the repaired adding machine.																						
II	22	Testing the operation of the repaired adding machine.																						
		HOME APPLIANCE SERVICING EXPERIENCES																						
I	1	Observing the symptom to determine the defect(s) in small heating element appliances.																						
I	2	Disassembling small heating element appliances for testing and repairing.																						
I	3	Isolating the defect to a particular section of the heating element appliance.																						
I	4	Isolating the defect to a particular component of the heating element appliance.																						
I	5	Replacing the defective part(s) of small heating element appliances.																						
I	6	Testing the operations of the repaired small heating element appliance.																						
I	7	Reassembling the repaired small heating element appliance.																						
I	8	Retesting the assembled small heating element appliance.																						
I	9	Observing the symptoms to determine the defect(s) in small motor driven appliances.																						
I	10	Disassembling small electric motor appliances for testing and repairing.																						

Figure 31, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	11	Isolating the mechanical defect(s) to a particular section of the small electric motor appliances.																						
I	12	Isolating the electrical defect(s) to a particular section of the small electric motor appliances.																						
I	13	Isolating the defect to a particular component of the small electric motor appliance.																						
I	14	Replacing the defective part(s) of the small electric motor appliances.																						
I	15	Testing the operation of the repaired small electric motor appliances.																						
I	16	Reassembling the repaired small electric motor appliance.																						
I	17	Retesting the repaired small electric motor appliances.																						
I	18	Connecting the electrical supply to the electric range in the home.																						
I	19	Checking the installation of the electric range and making any final adjustments necessary.																						
I	20	Explaining the operation of the electric range to the customer.																						
I	21	Installing the vent system for the automatic dryer in the home.																						
I	22	Connecting the electrical supply to the automatic dryer in the home.																						
I	23	Testing the installation of the automatic dryer and making any final adjustments necessary.																						
I	24	Explaining the operation of the automatic dryer to the customer.																						
I	25	Connecting the water supply to the automatic washer in the home.																						
I	26	Connecting the electrical supply to the automatic washer in the home.																						
I	27	Checking the installation of the automatic washer and making any final adjustments necessary.																						
I	28	Explaining the operation of the automatic washer to the customer.																						
I	29	Connecting the electrical supply to the refrigerator in the home.	S	S	S	S	S	U	S															
I	30	Checking the installation of the refrigerator and making any final adjustments necessary.	S	S	S	S	S	U	S															

Figure 31, continued

			Student																					
Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	31	Explaining the operation of the refrigerator to the customer.	S	S	S	S	S	U	S															
I	32	Observing the symptoms to determine the defect(s) in an automatic washer.																						
I	33	Disassembling the automatic washer in order to make the necessary repair(s).																						
II	34	Isolating the electrical defect(s) to a particular section of the automatic washer.																						
II	35	Isolating the mechanical defect(s) to a particular section of the automatic washer.																						
II	36	Isolating the defect(s) to a particular component in an automatic washer.																						
I	37	Replacing the defective part(s) of the automatic washer.																						
II	38	Repairing the defective part(s) of the automatic washer.																						
II	39	Reassembling the repaired automatic washer.																						
II	40	Testing the operation of the automatic washer.																						
II	41	Making any final adjustments to the repaired automatic washer.																						
I	42	Retesting the assembled automatic washer.																						
II	43	Observing the symptoms to determine the defect(s) in an automatic electric dryer.																						
II	44	Isolating the electrical defect(s) to a particular section of the automatic electric dryer.																						
II	45	Isolating the mechanical defect(s) to a particular section of the automatic electrical dryer.																						
I	46	Disassembling the automatic electric dryer in order to make the necessary repair(s).																						
II	47	Isolating the defect(s) to a particular component in an automatic electric dryer.																						
I	48	Replacing the defective part(s) of the automatic electric dryer.																						
II	49	Repairing the defective part(s) of the automatic electric dryer.																						
II	50	Reassembling the repaired automatic electric dryer.																						

Figure 31, continued

Level	Task No.	Task Statement	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	51	Testing the operation of the automatic electric dryer.																						
I	52	Making any final adjustments to the repaired automatic electric dryer.																						
I	53	Retesting the assembled automatic electric dryer.																						
II	54	Observing the symptoms to determine the defect(s) in a refrigerator.	S	S	U	S	S	U	S															
I	55	Disassembling the refrigerator in order to make the necessary repair(s).	S	S	U	S	S	U	S															
II	56	Isolating the electrical defect(s) to a particular section of the refrigerator.	S	S	U	S	S	U	S															
II	57	Isolating the mechanical defect(s) to a particular section of the refrigerator.	S	S	U	S	S	U	S															
II	58	Isolating the defect(s) to a particular component in a refrigerator.	S	S	U	S	S	U	S															
I	59	Replacing the defective part(s) of the refrigerator.	S	S	U	S	S	U	S															
II	60	Repairing the defective part(s) of the refrigerator.	S	S	U	S	S	U	S															
II	61	Reassembling the repaired refrigerator.	S	S	U	S	S	U	S															
I	62	Testing the operation of the refrigerator.	S	S	U	S	S	U	S															
I	63	Making any final adjustments to the repaired refrigerator.	S	S	U	S	S	U	S															
I	64	Retesting the assembled refrigerator.	S	S	U	S	S	U	S															
II	65	Observing the symptoms to determine the defect(s) in an electric range.																						
II	66	Isolating the electrical defect(s) to a particular section of the electric range.																						
I	67	Disassembling the electric range in order to make the necessary repair(s).																						
II	68	Isolating the mechanical defect(s) to a particular section of the electric range.																						
II	69	Isolating the defect(s) to a particular component in an electric range.																						
I	70	Replacing the defective part(s) of the electric range.																						
II	71	Repairing the defective part(s) of the electric range.																						
I	72	Reassembling the repaired electric range.																						
I	73	Testing the operation of the electric range.																						
I	74	Making any final adjustments to the repaired electric range.																						
I	75	Retesting the assembled electric range.																						

Figure 31, continued

RADIO AND TELEVISION SERVICING EXPERIENCES

Level	Task No.	Task Statement	Student																					
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
I	1	Observing the symptoms to determine the defective stage of the radio.	U	U	S	S	U	U	U															
I	2	Checking the tubes in the suspected defective stage of the radio.	S	S	S	S	S	S	S															
I	3	Removing the chassis from the cabinet for ease of servicing.	S	S	S	S	S	S	S															
II	4	Isolating the defective components in a particular stage of the radio.	U	U	S	S	U	U	U															
I	5	Replacing the defective components in a particular stage of the radio.	S	S	S	S	S	U	S															
I	6	Replacing the chassis in the cabinet after final inspection of the radio.	S	S	S	S	S	S	S															
I	7	Making final operational checks and adjustment to the radio.	U	U	S	S	U	U	U															
I	8	Observing the symptoms to determine the defective stage of the television set.	U	U	S	S	U	U	U															
I	9	Checking the tubes in the suspected stage.	S	S	S	S	S	S	S															
I	10	Removing the chassis from the cabinet for ease of servicing.	S	S	S	S	S	S	S															
II	11	Isolating the defective components in a particular stage of the television set.	U	U	S	S	U	U	U															
I	12	Replacing the defective components in a particular stage of the television set.	S	S	S	S	S	S	S															
I	13	Replacing the chassis in the cabinet after final inspection of the television set.	S	S	S	S	S	S	S															
I	14	Making final operational checks and adjustment to the television set.	U	U	S	S	U	U	U															
II	15	Installing an outdoor television's antenna and transmission line.																						

average, or below average. Evaluations of student skills and knowledges in the occupational areas of the cluster program were also summarized. A sample student abilities and interests inventory is presented in Appendix B.

Community involvement. The extent to which the community was involved in the electro-mechanical installation and repair cluster at School M was minimal. Teacher M did, however, obtain surplus radios, televisions, and large appliances from various repair shops in the community. Repair manuals for typewriters were also obtained from local repairmen. Little, if any, use of individuals in the community as resource persons was made and the class did not go on any field trips.

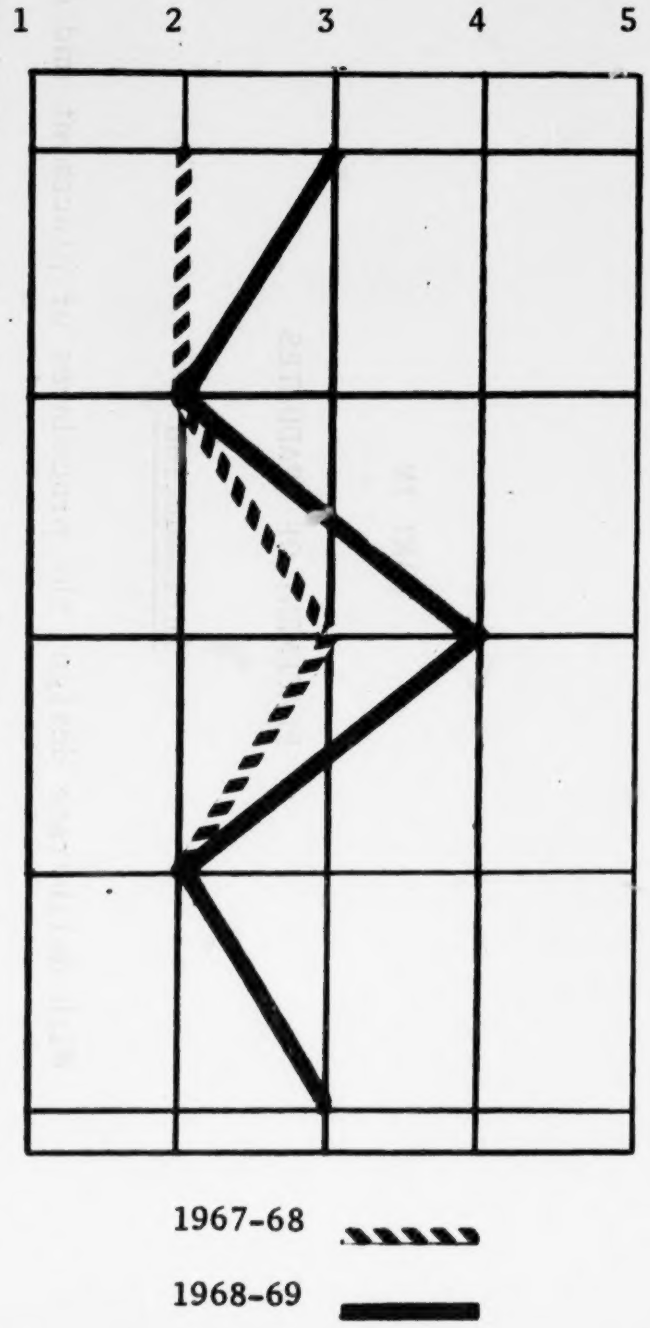
A visual summary synthesizing the preceding five areas (administration, teacher, physical facilities, instruction, and community involvement) which have been discussed in the description of the pilot program at School M is presented in Figure 32.

Figure 32.

SUMMARY-EVALUATION OF CLUSTER CONCEPT PILOT PROGRAM

SCHOOL M

	1	2	3	4	5
ADMINISTRATION	The school and county administrative personnel provided minimal moral and material support to the program and the teacher.		The school and county administrative personnel actively supported the program by furnishing the teacher with moral support but with less than satisfactory material support.		The school and county administrative personnel actively supported the program by furnishing the teacher with adequate moral and material support.
TEACHER	Little academic preparation in major field. Little or no teaching experience or practical experience in major field. Seldom shows resourcefulness or initiative.		Adequate academic preparation in major field. Has some teaching experience and some practical experience in major field. Sometime shows resourcefulness and initiative.		Superior academic preparation in major field. An experienced teacher with practical experience in major field. Resourceful. An initiator.
PHYSICAL FACILITIES	The size of the laboratory is inadequate and severely restricts occupational activities. The program also suffers from lack of equipment.		The size of the laboratory is adequate but somewhat restricts occupational activities. The laboratory has the minimum amount of equipment for operating the cluster program.		Size of the laboratory allows unrestricted occupational activities. The laboratory is suitably equipped for the cluster program.
INSTRUCTION	Tasks were taught in only one or two occupations. A very restricted number of Level I tasks were performed by the students. Few experiences offered were appropriate to the cluster.		Tasks were taught in several occupations. A majority of Level I tasks were performed by the students. Experiences were not always appropriate to occupations in the cluster.		Tasks were taught in all occupations. Most Level I tasks were performed by the students. Student experiences were extremely appropriate to occupations in the cluster.
COMMUNITY INVOLVEMENT	Community organizations were unaware of, or did not support the cluster program. Little opportunity for employment was evident in the community.		Community organizations furnished some support to the cluster program. Some members of the class found employment opportunity in the community.		Community organizations cooperated by furnishing aid to the program. A large proportion of the class found employment opportunity in the community.



PART IV

PLACEMENT OF GRADUATES

Introduction

With deliberate design, the procedures of placement and data gathered in this study assisted the student in the very important behavior of assessing his abilities and inclinations to choose an occupation from the opportunities made available to him. While we never attempted to determine the antecedent preorganizers of the student's choice, we hoped that the cluster programs were strong determinants and that the task analysis, human requirement inventories, and exploratory experiences served to enlighten the student in terms of his abilities and interests.

No attempt to study the specific process of vocational choice was made nor was it believed that choice ceased with the first decision to enter a job. No attempt to study the etiology of vocational choice, parental socio-economic level and personality characteristics was made.

In accordance with the rationale of the cluster concept program, vocational choice is considered as a continuous process composed of many diverse developmental qualities. The first job choice (in most cases) the student made included many compromises and required many adjustments. It may not even reflect a choice but an action prompted by some external demand of the labor market or home environment, or internal forces such as being frightened by the possible change of status and the wish not to leave the familiar way of life of the family. The first job chosen by the subjects in some cases reflected a departure from the expectations inferred from the MVII, the questionnaire and educational preparation. The longitudinal problem of duration of employment on the first job was not investigated, as the grant funds terminated two months after the subjects graduated. For this purpose, a new proposal was written and forwarded to the U. S. Office of Education.

Placement Strategy

For a four-year period, starting with the acceptability and feasibility studies, the research team and the teachers maintained various modes of interactions with leaders of industry. At times it was for purposes of consultation, acquisition of software and hardware, and periodically for permission to take students in a plant for a visit. It was during the time of this grant that efforts were focused on developing and implementing a strategy to provide an opportunity for graduates of the cluster concept programs to select their first post high school job with optimum freedom.

To identify prospective employers the Directory of Maryland Manufacturers, published by the Department of Economic Development, was reviewed. This document has within its pages the name, location, products, number of employees, and name of leading executives for every industrial commercial enterprise within the State. These industries, which incorporated activities and manufactured products which were directly or somewhat indirectly related to the activities of the cluster programs, were contacted by mail or phone.

Personnel and supervisory staff, and occasionally entrepreneurs were provided literature on the nature of, objectives of, and precise tasks of the cluster programs, and the general education experiences of the product.

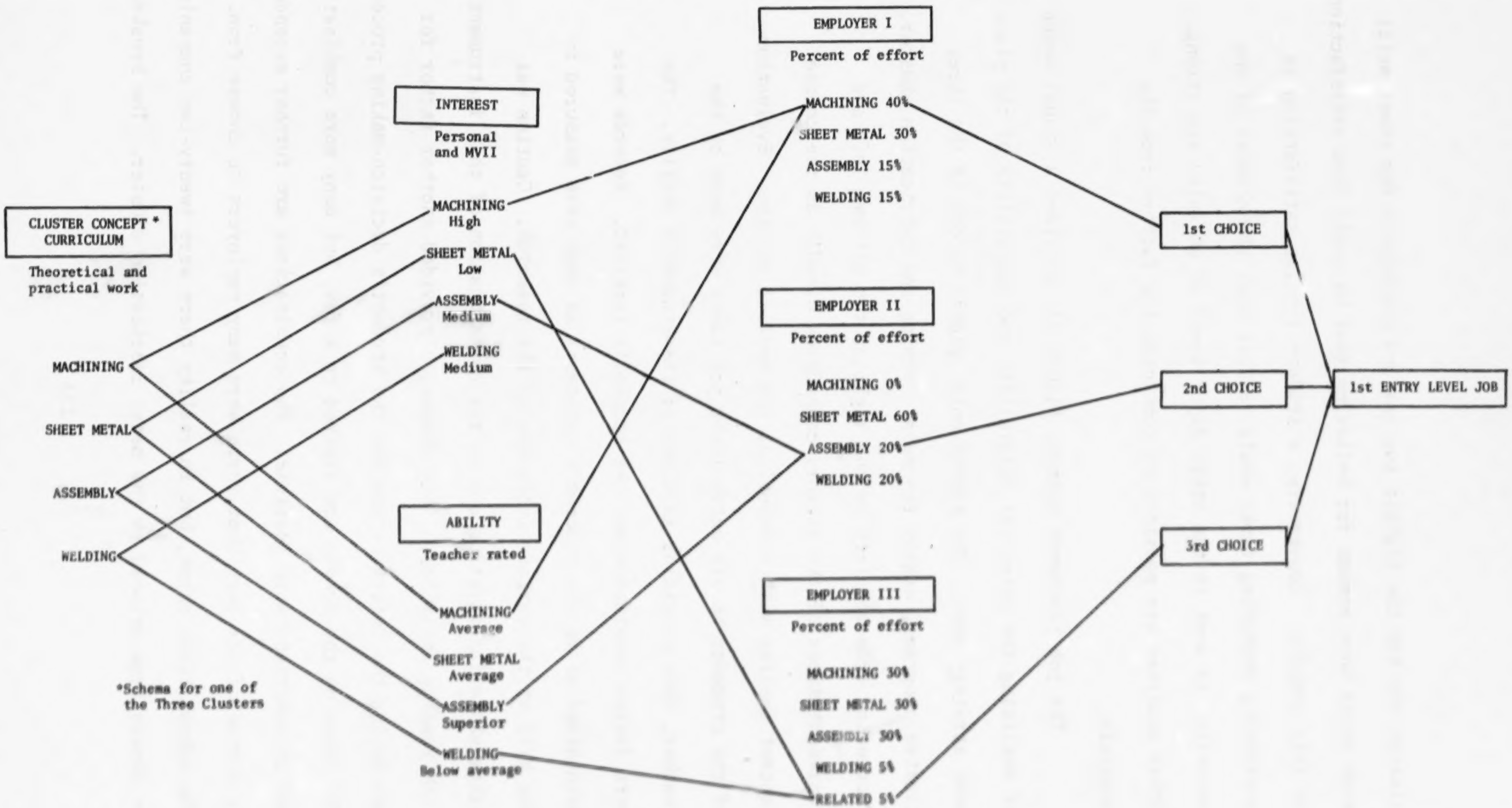
Directors of the office of the Department of Employment Security for the State of Maryland and the four counties in which cluster programs operated were also contacted.

Each cluster graduate was registered with the Office of Employment in his county. Several apprentice program directors were also contacted and excellent opportunities were identified. All employers who were contacted and those who expressed a desire to consider a cluster graduate for employment were requested to fill out a special form (Appendix D). This form was designed to provide an insight into the expectations and compensations for available and possible positions. The form also was a device which provided a rough estimate of the activities and a breakdown of the major company operations in percentages. An example of the value of this breakdown as it actually occurred is now presented. A company manufacturing mobile trailers for camping, offices, etc. expressed a desire to consider several boys from the metal fabrication cluster. The company listed its activities as sheetmetal work, 35%; welding, 8%; cabinet and trim work, 12%; tubing and fixtures, 10% ,and wiring, 10%; assembly, 4%; painting, 4%; fitting, 8%; machining, 2%; and delivery and other services, 7%. When the above information was related to a profile of student experiences, strengths and weaknesses in his studies and interests, a realistic choice on the part of the student was enhanced. A student who studied within the metal fabrication cluster who had the highest success and preference for sheet metal work would have reason for believing that he could find satisfaction in this company. Conversely, a student finding satisfaction in performing machining tasks would realize that the chances of the necessity to work in the other major areas of activity are strong. Other analyses are possible by combining the factors from the analysis.

The job placement schema, Figure 33, provides a visual means of realizing the potential flexibility and versatility of the placement strategy used. The schema only relates to one of the three cluster programs, namely the metal forming and fabrication cluster. Proceeding from the left to the right,at the extreme left are representations of the factors considered broadly as the course content dealing with theoretical and applied studies. Evaluation of the students on all entry level job tasks were made by the teacher, thus providing an index of the student's ability. The next factor considered was the student's interest. Records were maintained as to the student's interests as they were measured by the MVII at the various intervals of the research. Caution was taken while interpreting due to the contamination of this instrument with reading abilities. This dimension provided another factor for use during the interview and for the student's decision-making process. The lines on the schema are limited to a few, but many more combinations and interactions were possible. The combinations are further extended by virtue of the fact that there were many employers to choose from. The schema lists three, but in reality there were twenty-two companies to choose from related to the metal fabrication cluster. The breakdown

Figure 33.

JOB PLACEMENT AND SELECTION SCHEMA



*Schema for one of the Three Clusters

of the company in percentages of effort in production skills further enhances an understanding of the compatability of the student characteristics and the expectations of employers. The research team, employers, and guidance personnel could, by inspecting the preceeding factors for each student and with the breakdown list of many employers, with some assurance, provide good guidance information to the student. By inspecting the evaluations of the student's performance in the cluster program, occassionally a student was found to be low in applied task performances, but higher on the theoretical knowledge factor. This would lead to the suggestion of considering a job in related occupations as sales, purchasing, clerical stock man, etc., where the knowledge of the field is more important than manipulation. Finally, there were many companies for the student to choose from. On the schema only three choices are depicted, but more were possible. No effort was made to determine how or why a student ranked his preferances of companies. The variables for the study of the etiology of vocational choice would vary from student to student in an infinite number of illusive ways. His final choice of his first post high school job was the last observed behavior the study of this grant sought to determine.

As a means of providing employers with an estimate of student potential, an inventory of student interests,abilities,and performances of vocational tasks was developed. See Appendix B . This inventory only presented a summary of pertinent factors to enable ease of interpretation and limiting the time of reading. The task inventory included a precise record of the student's experiences and how well he could perform these. An employer was afforded a clear picture of the saleable skills a student possessed. Also in the interview the employer and the prospective employee could talk about the precise job expectations rather than a job defined in broad general terms.

From the survey, a list of employers (See Appendix E) was generated and made available to the students' guidance counselors and the research team. The personnel representatives of these firms were contacted and student interviews were arranged. This arrangement proceeded only if the student requested this help from the research team. Some students were self-motivated to secure a job on their own. In some cases, the students were escorted by the teacher or research staff to the company which expressed an interest in the students.

At the beginning of the month of June, or the termination of the school year, a number of students had been placed. The results of the placement efforts at that time are summarized in Table XVI.

While the students were afforded maximum opportunity for occupational choice, a number of external sociological forces prevented the planned 100 percent placement of all graduates. Eleven students were awaiting entry (some of these were actually serving) into the military service. Some graduates took part time or short duration jobs with the intent of leaving upon notification of being drafted. Some graduates chose to remain unemployed for a period of time to vacation or perform work around the house. In these cases, the graduates expressed no intent of remaining in the jobs permanently. Four subjects were under seventeen years of age. These boys were identified by employers as desirable employees and were encouraged to return for a job upon their eighteenth birthday. Three graduates took a role in the family business and farms. They indicated that the

TABLE XVI

FIRST JOBS OF GRADUATES

School	Total Number of Students	First Entry Jobs
Electro-Mechanical Installation and Repair Cluster:		
G	4	2 - U.S. Navy 1 - U.S. Marine School 1 - None
M	7	1 - Electronic Stock Clerk 2 - U.S. Navy 4 - None
Construction Cluster:		
A	13	2 - Farm Work 1 - Welder 7 - Building Construction 3 - None
C	5	2 - Masonry Construction 1 - Florist Shop Clerk 1 - None
D	4	2 - Masonry Construction 1 - Painter 1 - U.S. Army
H	12	1 - Plumber 1 - Cabinet Making 2 - Building Construction 4 - Auto Mechanic 2 - Farm Work 2 - None
Metal Forming and Fabrication Cluster:		
B	12	2 - College 10 - Metal Working
D (Teacher F)	4	4 - None
E	8	4 - College 1 - Metal Apprenticeship 3 - None
J	12	1 - Service Station Attendant 2 - Farm Work 2 - Metal Work 7 - None

construction cluster experiences met their needs.

Shortly after the end of the school year, within a few weeks after graduation, various behaviors of students were observed. The decisions made by students were reflected in the post high school activities presented in Table XVII. From the table it is evident that clearly thirty-nine percent of the graduates entered into jobs for which the cluster programs provided direct experiences. From interview data, it was found that subjects of this category tended to view these jobs as long duration occupations.

Fourteen percent of the graduates made plans to enter college and were holding jobs that required skills learned in the cluster programs.

Thirteen percent of the subjects entered or were committed to service in the military. Two students were known to be placed in branches of the service which required the skills and knowledge of the electro-mechanical cluster. It was too early to obtain full information relevant to all the military jobs the graduates were assigned to.

Twenty-nine percent of the graduates found it expedient to take unrelated work as their first post high school jobs. Some of these boys had the expectation of being called into the service in the near future. For others, it has not been determined what factors influenced the decision to take jobs in places like the post office, drug stores, gas stations and produce markets. A few boys had strong interests and studied in the construction cluster. However, the first job they entered into was with gas station and auto repair enterprises.

TABLE XVII

SUMMARY OF POST HIGH SCHOOL ENTRY JOBS

Cluster	A Employed in jobs directly related to cluster training	B College bound with cluster related jobs	C In military or committed to enter service	D Employed in unrelated cluster jobs	E Part time or unemployed by choice	F Job outside of cluster training awaiting assignment to related job	G Pending data from questionnaire
Construction	10*	3	7	12	1	2	6
Metal Fabrication	9*	4	2	5	4	2	5
Electro-Mechanical	3	1	2		1		3
Percentages	39**	14	13	29	11	7	11

*Two graduates entered apprenticeship programs.

**Based on all graduates employed full time.

Viewing vocational occupations as a pattern in a career, it may be found in a later follow-up study that the subjects will return to the areas of their strong interests and educational preparation.

The categories within Table XVII do not provide for subtle interactions. For instance, there were graduates in categories B, C, and G which could be combined with category A. It was estimated that category A could reach a percentage of 60 percent. This percentage would exceed the national average for the placement of vocational education students into positions directly related to their course of study.

Excluding the fourteen subjects for which data relevant to employment decisions were not available at the time of these calculations, it can be reported that 86 percent of the graduates were gainfull employed. This includes the combined number of full time cluster-related and unrelated jobs. These figures were based on the data gathered six weeks after school terminated. The figures were not accepted as final but as only a description of vocational behavior of the graduates at a given time. Further study of the development and patterns of vocational choice and their determinants would provide a more appropriate indication of the influence of the cluster programs on the occupational choices of the subjects.

PART V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The cluster concept, as structured, was aimed at the preparation of individuals for entry level capability in a variety of related rather than specific occupations. It was based on the premise that educational experiences with a broad range of related occupations appear defensible for most secondary students who have no realistic basis for decision making when selecting a specific vocation or trade. The program was designed to enhance the individual's potential employability by virtue of offering a wide range of entrance skills and a level of articulation across several occupational fields. It was believed that this type of fundamental training would enable the individual to move back and forth over several occupational categories as well as vertically within a specific occupation. It was also believed that the program would provide secondary students with a greater degree of flexibility for vocational decision making rather than compelling them to make a commitment to study within a "one-goal directed" traditional program.

This report is a summary of the fourth phase of research with the cluster concept program. The first phase of the research established the acceptability and feasibility of cluster programs and curricula for occupational clusters of construction, metal forming and fabrication, and electro-mechanical installation and repair. The completion of phase II resulted in the production of curriculum guides, course outlines, instructional materials and the selection and training of the necessary teachers to implement the programs in secondary schools of four counties in the State of Maryland. Phase III was an evaluation of the first year of experimentation and implementation of the cluster programs at the eleventh-grade level. Phase IV is considered within this report; it is an evaluation of the total effect of the cluster concept program after the second year of field research.

Research Summary of Phase IV

The problems and methods of procedure were extensions and replications of those described in phase III. The research was characterized as being "aexperimental"[1], where several variables in a field situation were investigated. Full control of all the variables necessary for an ideal experiment was not achieved. As such, it was designed to generate several types of data for the purpose of evaluating the cluster concept programs while they were implemented in the field. Descriptive, comparative, and quantitative data were used to assess the impact of the two-year program on the student, teacher, administration, the adequacy of the instructional materials and environmental conditions.

Problems

The problems investigated were those which provided further evidence of the effectiveness of the cluster concept programs of studies in a field setting. The four principal areas of investigation included the determination of:

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[1] Egon G. Guba, "Methodological Strategies for Educational Change," Paper presented to the Conference on Strategies for Educational Change, Washington, D.C., November 8-10, 1965, Columbus: School of Education, Ohio State University, 1965, 38 pp.

1. The impact of the cluster program on selected cognitive, affective and psychomotor (task performances) behaviors, and finally, occupational choice and placement of the graduated subjects of the experiment.
2. The adequacy and the appropriateness of the content and methods of the cluster program and instructional materials.
3. The educational process, its adequacy and appropriateness with a consideration of: administrative support, teacher effectiveness, and environmental conditions.
4. The employability of the graduates of the cluster program in the occupations for which they sought to gain entry level skills.

A. By completing research with the pretest and posttest with control and experimental group type of design, the following cognitive changes of behavior were studied:

   1. The achievement or the ability to perform level I and level II tasks identified in the cluster concept courses of study.
   2. The student's technical knowledge relative to commonalities of human requirements for various occupations.
   3. The student's achievement of knowledge related to the requirements, characteristics, and opportunities of occupational fields within the parameters of the cluster he was engaged in.

B. The affective changes or impact of the cluster concept program on selected vocational interests, vocational preferences and aptitudes were analyzed in terms of trends, shifts, or changes empirically determined. The instruments used are outlined in Table I. The following questions were studied:

1. Do students of the cluster program tend to change or extend their vocational choices?
2. Do students of the control or experimental group tend to have stable occupational interests?
3. Will the control or experimental group demonstrate a significant change in vocational aptitudes?

C. Specific performance tasks for level I and level II jobs were identified and catalogued. These tasks were all stated in behavioral terms for purposes of objectivity during evaluations. These task inventories provided:

1. Precise knowledge about the type and kind of manipulative (psychomotor) tasks a student can perform.
2. The parent, teacher, student, and employer with available a complete inventory of the experiences the student had by virtue of completing studies in the cluster programs of his choice.

The second area of investigation was performed to evaluate and to assure control and the proper functioning of the programs throughout the two years. Feedback information, gathered by the visiting research team from schools operating cluster programs, provided descriptive data and a history of events recorded by the use of evaluative scales and anecdotal records. The various tasks that were structured into the

cluster programs, as expected behaviors of performance, were used as an index to determine what has and has not been completed during the two years and as a criteria for evaluating student performance.
criteria for evaluating student performance.

The third area of investigation was concerned with the study of selected supportive dimensions, including the administrative behavior, material and moral support, physical facilities, and teacher effectiveness. These evaluations were presented in descriptive terms, whereas an appropriate attempt was also made to quantify certain categories of observed behaviors.

The fourth area of the project concentrated on assisting students in entering their first post high school jobs. Since the cluster concept program was developed with the aid of industries including similar occupations of each cluster, their aid as well as many others was sought for job placement. The problems investigated were:

1. Was the trend of the rate of employment of the cluster graduates higher than that of traditional vocational programs?
2. After placement on the first job did the students' choices reflect their cluster experiences?

The impact on student cognitive behaviors. 1. To investigate the degree and nature of behavioral changes of students who studied within the cluster concept program, control and experimental groups were established. The experimental group completed two academic years of training in a cluster program taught by specially trained teachers of varying abilities. For the same interval of time a comparable group, the control group, pursued singular goal-directed vocational courses.

Both groups were tested on a battery of pretests and posttests measuring the variables considered central to determining the effect of the experiences gained in the cluster programs. The tests included newly developed achievement tests for each cluster, the Minnesota Vocational Interest Inventory, the D.A.T. Mechanical Reasoning Test, and an instrument to evaluate the students' knowledge of occupational information.

Control variables were incorporated to assure continuous functioning of the programs and the identification of comparable students. Scheduled visitations conducted by the research team and instructional materials served to keep the programs and activities on the prescribed course. Verbal or linguistic ability and intelligence scores were obtained from school records to establish a criteria for comparability of the subjects. In several schools these were not available; however, intelligence scores or scores from the Mechanical Reasoning Test served to determine the homogeneity of students. This study did not circumvent the limitations created by inadequate samples, the differences in the art of teaching, and the limitations of reductionism which does not consider homo-sapiens as a total organism. Each school operation was considered unique and each program was evaluated independently.

Full control of all the variables necessary for an ideal experiment was not achieved; therefore, this study was completed in the tradition of quasi-experimental design with full recognition of the factors which rendered the results equivocal.

Collection and treatment of data.- Subjects from ten senior high schools in four Maryland counties have participated in this study. One school had two cluster programs, each taught by a cluster instructor;

thus, eleven teachers and eleven separate cluster programs were included. Each cluster program was compared with a control group composed of students from a traditional vocational education course. Each school was considered and evaluated as a separate experiment.

Comparability or homogeneity of the students forming both groups was established on the basis of intelligence test scores, or in some schools, on the basis of lingual or verbal abilities scores, and in another, on the basis of scores from the D.A.T. Mechanical Reasoning Test. The statistical treatment and review of data is presented in the final report of phase III.

The effectiveness of the treatment on the cognitive abilities, as measured by the newly developed cluster concept tests and the Mechanical Reasoning Test, was investigated. The investigation included the determination and analysis of:

1. Differences in abilities of students from each group on scores derived from tests at the beginning of the experiment.
2. Final differences between the experimental and control groups on the basis of pretest and posttest scores.
3. Growth or gains in cognitive abilities of all groups on the basis of the differences between the pretest and posttest. (See Final Report, phase III).

Findings: construction cluster.- The following findings are derived from research of phase IV. Phase III findings varied from these and are reported in the final report for 1968.

Four schools implemented the construction cluster programs. The subjects of the programs had an intelligence quotient range from 87.93 to 99.27. Achievement test data indicated that one school was successful (and significantly so) meeting the cognitive objectives of the cluster programs while the other three were observed to have moderate success.

In School A the cluster groups achieved significantly higher scores over the control group on posttests of achievement.

Data derived from Schools C, D, and H supported the finding that only a modest increase in student cognitive abilities was achieved. By analysis of the responses of students to the construction cluster test, it was evident that the students were not provided experiences in all the tasks prescribed for the program. Data measuring the difference between the control group and the cluster group tended to show an increase but this fell short of being statistically significant.

The investigation of the cluster programs and traditional programs on the achievement of those abilities measured by the Mechanical Reasoning Test yielded the finding that both programs had an insignificant effect on the students.

Recommendations.- Since the data indicated that the objectives of a cognitive nature have been met with varying degrees of success, it was recommended that cluster teachers,as well as teachers of related subjects,deliberately emphasize those objectives and that a balance be established between manipulative and theoretical studies. To achieve this balance, more time and pedagogical effort should be alloted to the study of the underlying knowledges and problem solving skills associated with the construction trades of carpentry, masonry, plumbing, painting, and electricity. This could be done in the math and science courses.

Test analysis revealed that some of the participating teachers emphasized the human requirements of one or two occupations and gave only token consideration to the human requirements of other occupations. Truncation of the cluster program or incomplete consideration of the tasks must be avoided.

The full impact of the strategically contrived instructional process was not achieved. Nullifying effects impinging on the instruction were caused by problems of logistics, administrative support, the lack of equipment, proper facilities, and teacher dedication. Many of these problems emerged due to the concurrency of evaluation and implementation during the two years of operation. It is reasonable to believe that such problems, in a large measure, would not appear if the field operations were performed for two years or one cycle before conducting an evaluation of the effectiveness of the programs. Teacher differences in ability and sustained effort in the face of discouraging difficulties correlated with the success of the programs.

Findings: metal forming and fabrication cluster. Four distince cluster groups and control groups were used for investigating the effectiveness of the programs. The subjects comprising the sample population had a range of intelligence quotients set by a low of 95.44 and a high of 104.20. Data derived from thetotal test scores of the metal forming and fabrication cluster test provided evidence that all schools were achieving the cognitive objectives.

Statistical treatment applied to data derived from posttests of both groups provided evidence that the experimental group achieved significantly higher scores than the control group. The observed changes of behaviors provided evidence that the cluster program was achieving the cognitive objectives.

Research data derived from the D.A.T. Mechanical Reasoning Test indicated that both types of vocational education programs had an insignificant effect on the development of the abilities required to solve problems of applied science and technology. Since the subjects studied other subjects, it can be said that the total school program produced no difference on the variables measured by this instrument.

Recommendations.- Analysis of the achievement tests provided evidence that students had varying degrees of success in the knowledges of welding, machining, sheet metal and assembly work. While total test scores indicated that the objectives were being met, the variability of the scores from each sub-area suggests that teachers were emphasizing certain units of study more than others. The reasons for this behavior were due to the many variables impinging upon the teaching process. These reasons are presented in the following pages. It was recommended that complete consideration be given to the teaching of each occupational task.

Since the various abilities of the four teachers complemented each other, seminars and small group meetings should be held to enable the teachers to exchange and share their special talents. Team teaching would greatly advance the cluster program; however, the proximity of the various schools made this impossible. Those seeking to adopt these programs should seriously consider this suggestion.

Findings: electro-mechanical installation and repair.- Initially, this program involved three schools. Due to many diverse problems of scheduling and other failures to meet the basic expectations for operating a cluster program, one field operation was discontinued. Consequently, two field operations completed two years of work implementing the new program.

Neither school achieved high enough scores on the achievement test to enable the recognition of significant differences between the control groups and experimental groups during the first year of operation. The control groups were composed of a student body with relatively stronger backgrounds in the study of electricity than the cluster groups. The subjects of the control group also tended to be more capable on the performance of the Mechanical Reasoning Abilities Test. During the second year of operation the subjects who served as a control group for this cluster were lost, due to an unusually high attrition rate at both schools.

The cluster programs encountered many difficulties in the procurement of proper facilities and equipment such as business machines, refrigeration units, and air conditioning equipment. These problems caused severe delays for implementing those areas of study which would enable the students of the cluster group to gain knowledge which distinguished the differences between the programs.

Recommendations.- The pilot programs were found to be short of representing a model of the electro-mechanical cluster. It was found that more concentration of pedagogical effort was required in the subject fields of typewriter repair, business machines and air conditioning. The teacher in this cluster program must extend both the variety and the depth of the study of the occupational tasks and human requirements outlined in the cluster concept instructional materials. It will be necessary to provide instructors with additional training and experience to upgrade their competencies.

Affective behaviors. The affective behaviors studied were limited to occupational preferences and interests measured by the Minnesota Vocational Interest Inventory and a supplementary questionnaire constructed by the research team. The purpose of this aspect of the study was to obtain an estimate of the impact the cluster concept program made on students by comparing data derived from control and experimental groups. The basic rationale of the cluster program is based on the premise that occupational interests should be broadened and that a student should remain flexible as to his comitment to an occupational choice. Accordingly, it was expected that students engaged in the traditional "one-goal directed" vocational program would manifest different behaviors than the cluster concept students.

Collection and treatment of data.- The MVII was administered by the research team on a pretest-posttest basis. The administration time varied extensively and it was necessary to allow several class periods to complete. The students were encouraged to persevere at the task since they generally were slow readers. The test answer sheets were scored commercially. Upon their return tothe research center, they were analyzed and studied for dissimulatin and other irregularities. A master profile chart was constructe which enabled data for each student to be recorded and readiy observed. From the master charts summary tables were made which included quantified data in terms of frequencies and percentages. The tables are presented in the text of this report.

Findings.- The data derived from the MVII were perplexing and generally unsatisfactory for clear analysis. Small differences between pre- and posttests and control and experimental groups were observed. No clear patterns or directions of student preferences were found. A greater degree of fluctuation in the direction of or away from occupations the students actively studied was observed; whereas, less fluctuation of choice for unfamiliar occupations was exhibited. Slightly more diversity or flexibility of choice was observed to take place within the cluster group than the traditional vocational education group.

Recommendations.- The modest changes of behaviors of the subjects strongly suggest that more deliberate effort needs to be exerted in providing students with occupational information. This should be done by school guidance personnel as well as the teachers. Field trips to industrial plants, guest speakers from management and skilled workers, audio-visual devices, and special resource personnel should be used to further develop a realistic understanding of the students' knowledge of vocational requirements.

The supplementary questionnaire.- A supplementary instrument was developed to obtain an estimate of the students' knowledge and attitude relevant to selected job factors such as human relations, status, security, advancement, remuneration, changes of job requirements and geographic displacement. By this means the research team sought to obtain evidence for determining if the objectives of occupational information were being implemented. The questionnaire was administered at the beginning and at the end of the experiment.

Findings from the supplementary questionnaire.- Within the various groups of subjects, it was found that between 25% and 40% of the boys were dissatisfied with high school and would prefer to be productively employed or pursuing on-the-job training.

Of the students who realized the value of completing high school, an increase in the number of students preferring to study in a technical institute was observed.

The students' attitudes pertaining to geographic mobility remained relatively unchanged. On both the pre- and post measures there were slight indications of preferences for the desire for jobs away from their present locations. An increased acceptance of the idea for the need to upgrade themselves, as the technology changes, was found. There was also an awareness that this was essential for promotion, increased wages, and an improvement in status.

On the basis of the differences from the pretest to the posttest measures, the number of students who expressed an appreciation for obtaining broad entry level skills as opposed to specific in-depth training increased.

A more detailed analysis of the items of the questionnaire are provided in the text. A comparison of the expressed feelings with actual entry job choices can be made by referring to Part IV.

Recommendations.- The objectives of the cluster program which sought to promote an understanding of the concepts that occupational selection and career development is a life-long process, were modestly achieved. Deliberate effort on the part of the teachers to discourage the mechanistic viewpoint of the one right, life-long job for each person, must be advanced. Examples of how background experiences can be parlayed into a career should be provided.

Evaluation of task performances of students and teachers.

2. The effectiveness of the three cluster concept programs were further investigated by indirect methods. Field observations were conducted during which evaluations and records of specific overt behaviors of students and teachers were made. The specific behaviors were referred to as job tasks or the expected performance tasks and set forth in objective behavioral terms proposed by Gagne.[2] The tasks were incorporated into the course materials, inventory charts, and evaluation charts. The teachers' progress in implenenting the instructional materials and student progress were recorded by the use of these devices. Data were collected by scheduled and unscheduled visitations conducted by the research team.

The progress and evaluation charts provided a record of those tasks completed, those tasks that were completed but needed further study, and those tasks which, for one reason or another, were not considered at all. The task evaluation charts provided records of the tasks each subject completed in terms of satisfactory, unsatisfactory or not experienced in the program.

Findings: related to manipulative tasks.- The number of tasks completed varied from teacher to teacher. It was evident that some tasks of occupations within a cluster were adequaely executed whereas in others they were not. Teachers tended to ephasize those tasks which reflected their background experiences andinterests.

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[2] Robert M. Gagne, *The Conditions of Learning* (NewYork: Holt Rinehart and Winston, Incorporated), p. 243.

During the two-year pilot programs the range of tasks completed for the metal forming and fabrication cluster programs was from 67 to 98 percent. The construction program group completed from 52 to 79 percent of the tasks specified in the two-year programs. The electro-mechanical cluster completed from 29 to 60 percent of the occupational tasks.

The number of tasks completed during the first and second year is summarized in Table XVIII.

TABLE XVIII

TASK SUMMARIES

School	1st year completion	2nd year completion	Total tasks in program
Construction			
A	33	69	101
C	28	52	
D	32	78	
H	39	41	
Metal Forming			
B	70	89	141
D*	77	139	
E	71	91	
J	69	87	
Electro-Mechanical			
G	47	71	119
M	32	34	

*School D had two pilot programs.

The fact that no field operation completed all the tasks was taken to indicate that the instructional programs developed were adequate. However, since advances in technology cause changes in job requirements it will be necessary to develop and change tasks. Some improvements are suggested in the Supplementary Task lists in the Appendix F. These extend the list provided in phase I. The specific changes should be made by the consideration of each program and in the manner followed in phase I. This required the involvement of teachers, incumbent job experts and consultants from business and industry.

Recommendations.- Activities designed to implement the tasks are suggested in previous documents. Supplementary activities of two general types are recommended. It was required to provide individual projects for initial learning and practice followed by group orientated activities involving coordination of a large number of tasks from two or more occupations within a cluster. Attempts should be made to bring students closer to the problems faced in the world of work stemming from interactions between individuals working together.

Two kinds of activities are listed in Table XIX for each cluster. One is intended mainly for individual competency-building exercises within one occupation while the other is intended for group participation and experiences with coordinated tasks from several occupations. The activities are typical of those carried out in the pilot operations and represent suggested experiences rather than a comprehensive listing.

Evaluations of the instructional process. 3. The third area of investigation was concerned with the evaluation of selected supportive dimensions including the: (a) administration, (b) teacher, (c) physical facilities, and (d) community acceptance.

TABLE XIX

SUGGESTED MEDIA FOR EXPERIENCES

CONSTRUCTION CLUSTER

Medium for Experiences within a Single Occupation	Medium of Experience Integrating Jobs from Several Occupations
Cast concrete-splash blocks " " -bicycle racks " " -patio blocks	Tool sheds Garden houses
Laying-up corners with brick and concrete block	Play houses Corner sections
Painting school facilities	Green houses
Sawhorses	Bus stop shelters
Picnic tables	Kennel buildings
Finishing and refinishing operations on household furniture	
Pipe- clothes racks uniform racks bicycle stands	
Maintenance operations in the school shop such as rewiring and construction of storage facilities.	

ELECTRO-MECHANICAL INSTALLATION AND REPAIR

Medium for Experiences within a Single Occupation	Medium of Experience Integrating Jobs from Several Occupations (Maintenance and repair of)
Flare tubing	Freezers
Swedge tubing	Refrigerators
Solder- soft silver	Small appliances
Brazing	Stoves
Wiring series and parallel circuits	Dryers
	Window air conditioners
Performing basic test operations with meter- and oscilloscope	Radio and television sets
Applying Ohm's Law to practical situations.	Typewriters
	School sound systems

METAL FORMING AND FABRICATION CLUSTER

Medium for Experiences
within a Single Occupation

Center punch

Drill gauge

Coldchisel

Nut and bolt storage tray

Tool box or tray

Scriber

Hammer

Drill press vise

Screwdriver

Hollow sheet metal punch

Charcoal hod

Waste basket

Dust pan

Medium of Experience Integrating
Jobs from Several Occupations

Jack stand

Snow blower

Stationary steam engine

Wrought iron furniture

Mobile bar-bell rack

Boat trailer

Portable automotive engine
block crane

Garden cart

Tackle blocks

Utility trailer

Car-top boat rack

For a lack of a rigorous, quantitative methodology to evaluate the dynamic process such as the art of teaching, the methods resorted to were visitations, gathering data by observation, and the rational interpretation of data and events. The research team made vigorous efforts to gather information on the basis of objective and observed behaviors. In addition to anecdotal records, the following devices were a means of obtaining data:

1. Personal vita and records of cluster teachers.
2. Interviews with the administrators of the schools.
3. Survey forms for an inventory of the tools, materials, and equipment for each cluster.

5

4. Drawings and sketches of physical facilities.

5. Visual media such as drawings, plans, photographs, and written descriptions of practical work performed while implementing the course outlines.

6. Student progress charts.

7. Student evaluation charts.

Findings: construction cluster.- The construction cluster was implemented in four counties. Administrative support from the state, county and local levels ranged from enthusiastic verbal support to active participation in overcoming the problems of procurement of materials and equipment.

All teachers of the construction cluster had varying pedagogical abilities but on the whole had adequate practical experiences and academic backgrounds. Teachers with degrees in industrial education tended to conduct the program in a superior manner. Most teachers tended to emphasize those occupational tasks for which the laboratory was originally designed and equipped. Various degrees of teacher effectiveness and enthusiasm in the face of difficulty were observed. One teacher conducted an outstanding program which met all expectations of the research and provided the students with almost all of the tasks specified in the instructional materials.

The programs were conducted in laboratories which were too small for the diverse activities required in the cluster program and frequently cluster activities were performed on the school grounds.

Varied activities of interaction with the community were observed. All teachers conducted field trips to construction sites and industrial manufacturers and discussed employment opportunities and requirements. A few resourceful teachers obtained free materials to augment their stock of materials and supplies used in construction industries. Through the efforts of the research staff, local newspapers disseminated information describing the cluster concept program.

Findings: metal forming and fabrication cluster.- Four separate field operations were implemented in this cluster. All teachers of this program had B.S. degrees and varying amounts of time in advanced graduate course work, military service, and industrial experience. While variability in the art of teaching existed, this group of cluster teachers was evaluated to be most effective in meeting the expected goals of the new programs.

The use of laboratories which were designed for the study of a single occupation did not provide sufficient working area and in some situations, ample source of power demanded by the varied equipment for the new program.

Teacher interaction with the industrial firms resulted in the procurement of free materials, technical information and post high school jobs for the graduates.

Findings: electro-mechanical installation and repair.- This cluster program did not escape the damaging effects caused by lack of opportunity for the teachers to practice-teach their newly acquired skills, inadequate supplies, materials, and equipment. The requisition-acquisition time lag strongly suggests that all programs should have been in operation several years before an evaluation was attempted.

Both teachers were resourceful in obtaining some materials and equipment from local commercial establishments. They tended to place more emphasis in the study of air conditioning, refrigeration,and typewriter repair with little or no consideration of the other facets of the cluster program. A neglect to utilize community resources for class field trips and the lack of confidence while teaching new tasks was evident.

Recommendations.- Suggested physical facilities are presented in the form of floor plans in Part III, Figures 10, 19, and 28. These are based on the mini-max concept or the approach to accomodate the maximum cluster activities with minimum physical facilities and equipment. Variations and extensions of the plans presented can be made by the application of creative abilities and good judgement. Some salient aspects for drawing up specifications are also presented.

The layouts were made with a consideration of the type of activities demanded to complete the units of studies for each occupation and for projects where occupations were integrated. Individual, small team, and large group activities were used in implementing the programs. Individual stations, large work and assembly areas, and lecture areas were considered in terms of traffic flow or movement of personnel and materials. The classroom was considered the heart of the pedagogical process used daily for lecture and instructional films. Demonstrations were not always possible in the classroom. When this occured, the actual work area was used.

To afford the teacher with maximum visibility all interior walls should be non-load bearing where necessary work areas could be outlined with walls no higher than three feet. If an area needs to be enclosed to confine dissipation of dust or odors, plastic or glass partitions could be set on the low level walls.

The diverse activities of the cluster concept curricula demand more than the normal amount of laboratory planning. The wide range of equipment, tools, materials, storage space and work areas require consultation services for purchase and organization. The revised list of equipment, tools, materials for each cluster is presented in Appendix C . In Tables XX, XXI, and XXII are some factors for consideration by planners who would seek to implement the cluster concept programs.

Placement efforts.- The fourth dimension of the project was concerned with assisting the subjects of the cluster programs in making the transition from school to the world of work. The extra efforts in job placement activities (see Part IV) such as ; developing school and community awareness, the systematic preparation and presentation of student experiences, interests and abilities, and the analysis of employer activities, provided an optimum service to the students.

The study of job placement and development properly executed demands longitudinal research. The data for this report was gathered immediately after and within four weeks after graduation. At that time it was found that 86 percent of the graduates were gainfully employed. A number of students by their own preference decided to vacation or await the time for entry into the military service.

Recommendations.- An attempt should be made to study the etiology of vocational choice, including parental socio-economic level, type of community restrictions and personality characteristics. This knowledge may add a new dimension for use with the future development and refinement of cluster programs.

TABLE XX

FURTHER FACTORS FOR LABORATORY PLANNING CONSTRUCTION CLUSTER

	Wood floor	Cement floor	110 - 220 Volt	Compressed air	A-B-C extinguisher	Dust collection	Vacuum cleaner	Floor brooms	Combustible liquid storage	Protective clothing	Eye protection	Safety shoes	Gloves	Dust mask	Ladders	Cutting oil	Non-load bearing walls	Overhead doors	Outdoor work area	Exhaust system
Carpentry	X		X	X	X	X	X	X			X	X			X		X	X	X	
Masonry		X					X	X		X	X	X	X				X	X	X	
Painting		X		X	X		X	X	X	X	X		X	X	X		X			X
Plumbing		X			X		X	X		X	X	X	X			X	X		X	X
Electricity	X		X		X		X	X			X				X		X		X	

TABLE XXI

FURTHER FACTORS FOR LABORATORY PLANNING
METAL FABRICATION CLUSTER

	Wood floor	Cement floor	110 - 220 volt	Compressed air	A-B-C extinguisher	Exhaust system	Vacuum cleaner	Floor brooms	Combustible liquid storage	Protective clothing	Eye protection	Safety shoes	Gloves	Cutting oil	Lubricating oil	Non-load bearing walls	Overhead doors
Welding		X	X		X	X	X	X		X	X	X	X			X	X
Machining		X	X	X	X		X	X	X	X	X			X	X	X	X
Assembly		X					X	X	X		X	X	X			X	X
Sheet metal	X						X	X			X		X			X	

TABLE XXII

FURTHER FACTORS FOR LABORATORY PLANNING

ELECTRO-MECHANICAL CLUSTER

	Wood floor	Cement floor	110 - 220 volts	Compressed air	A-B-C extinguisher	Exhaust system	Vacuum cleaner	Floor brooms	Combustible liquid storage	Protective clothing	Eye protection	Gloves	Low voltage source	Tape recorders	Aerial	Service manuals	Tube tester	Non-load bearing walls	Overhead doors
Radio & TV	X			X	X		X	X			X				X	X	X	X	
Air Conditioning	X		X	X	X	X	X	X		X	X	X				X		X	X
Home Appliances	X		X	X	X	X	X	X		X	X	X	X			X		X	
Typewriter-Business Machines	X			X	X		X	X	X					X		X		X	

Final Statement

The action research conducted made it evident that these special types of cluster concept programs have the potential of becoming vigorous, alternate forms of vocational education. It was concluded that the programs did change student behaviors in the direction of the established objectives. Changes in behaviors, of cognitive abilities, of broadened interests, flexibility of occupational interests, and growth in performance tasks of skill were observed.

Finally, there was a substantial number of graduates who entered the world of work, thereby beginning the development of their careers and becoming useful citizens contributing to society.

The inadequacies (to fully resolve the problems encountered) should not in any measure be taken as reasons to discard the program; rather that which is known to be sound and effective should be retained and that which was found to be faulty provide a further challenge to the developmental process.

Judged by the acceptance and interest expressed by thoughtful leaders of education, it is clear that the programs are gaining momentum. (See Appendix G , Information Request List). The U.S.O.E., the Maryland State Department of Vocational Education, the University of Maryland, and all citizens have an investment to protect. Leading professional organizations should stimulate and facilitate collective and individual efforts in the diffusion of this alternate form of vocational education. Acceptance of the programs require attitudinal changes on the part of many practitioners who feel that the institutionalized concept of vocational education is sufficient.

For these people, leadership should be provided so that they might become better consumers of research findings, particularly they should become cognizant of those studies which formed a basis and rationale for cluster concept programs. Justification for the existance of the programs was derived from the fact that support for the establishment of such programs was suggested by disciplines other than vocational education.

It was recommended that there be a larger acceptance and replication of these programs so that they can be evaluated by professionals other than those who developed the concept.

With the completion of this study, the theory, methodology and all practical aspects of implementation have been investigated. The breakthrough has been made;more schools should accept this alternate form of vocational education. A great potential now exists to develop more and varied programs to enrich vocational education and meet the needs of American youth in an ever-changing technological era.

APPENDICES

APPENDIX A

APPENDIX A

ACHIEVEMENT TEST

CONSTRUCTION CLUSTER

Do not open this booklet until you are told to do so.

On your SEPARATE ANSWER SHEET print your name, address, and other requested information in the proper spaces then wait for further instructions.

DO NOT MAKE ANY MARKS IN THIS BOOKLET

Cluster Concept Program

Industrial Education

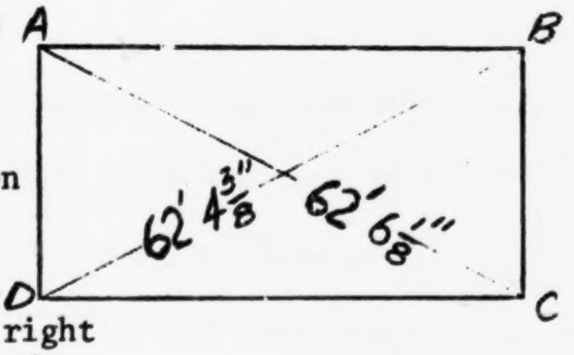
Directions for multiple-choice items requiring the BEST answer.

Each of the questions or incomplete statements listed below is followed by several possible answers. Choose the answer that best answers the question or completes the statement. Place the identifying letter of that answer (A,B,C,D, OR E) in the numbered blank space on the answer sheet that corresponds with the question on the test sheet. MARK ALL ANSWERS WITH A SOFT PENCIL - FILL IN THE SPACE COMPLETELY.

1. The best way of nailing down the sole plate of an exterior partition for a home is to nail it so the nails pass into the

    a) rough floor
    b) floor joists
    c) header
    d) sill
    e) B and C

2. In squaring up a foundation the distance AC and DB are measured and found to be 62' 6 1/8" and 62' 4 3/8" respectively. The distances AB and DC, and BC and AD are correct. To square up the foundation



    a) points D and B should be moved an equal distance to the left
    b) point B should be moved to the right
    c) point B should be moved up towards the top of the page
    d) points D and C should be moved an equal distance to the right
    e) none of these will correct the situation

3. The easiest means for one man to cut 4 x 8 plywood sheets to size for rough floor, sheathing and roof deck on a house is by using

    a) a radial saw
    b) a table saw
    c) a band saw
    d) a portable electric jig saw
    e) a portable electric circular saw

4. A gable stud

    a) runs from the double plate to the rafter
    b) is part of the roof overhang
    c) has a bevel cut on each end
    d) is a horizontal member placed above and below the louver
    e) is none of these

5. Building paper is used between finish siding and sheathing to prevent

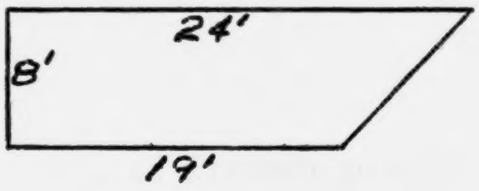
   a) passage of moisture
   b) passage of air
   c) passage of dust
   d) A and B and C
   e) A and B

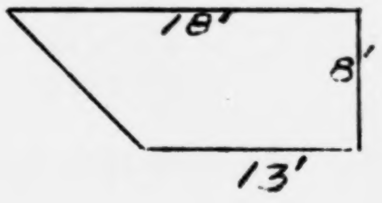
6. When possible the metal drip edge should be nailed so the nails pass into the

   a) fascia
   b) roof boards
   c) roof rafters
   d) the cornice
   e) the header

7. How many rolls of building paper are required to cover the two areas at the right? Each roll covers half a square.

   a) 3 rolls
   b) 7 rolls
   c) 5 rolls
   d) 6 rolls
   e) 9 rolls





8. The most practical and sensible way to clean a 12" tar brush would be to use
   a) gasoline
   b) turpentine
   c) kerosene
   d) alcohol
   e) detergent

9. A lag shield

   a) is put in place with an impact tool
   b) requires a hole the same size as the lag screw it is used with
   c) holds in the wall because of expansion pressure
   d) is screwed into the hole which is drilled for it
   e) cannot be removed once it is put into place

10. Batt or blanket insulation is most easily installed with a

   a) hammer and large head nails
   b) stapling hammer
   c) mastic cement
   d) stapling gun
   e) lath strip and wire nails

Appendix A, continued

11. A drywall installation

    a) can be made quicker than a plaster installation
    b) may be made in two layers
    c) uses either 3/8" or 1/2" thickness board
    d) can be made with nails or cement or both
    e) all of these

12. The normal procedure in preparing dry wall joints for prime paint is to apply joint cement or compound in

    a) 2 coats
    b) 3 coats
    c) 1 or 2 coats
    d) 4 coats

13. If the following lengths of material are needed: 2-16", 1-2'3", 3-2'9", they could be cut with the least waste from standard stock lengths by using

    a) 1-12'
    b) 1-14'
    c) 2-8'
    d) 1-10' and 1-6'
    e) 1-16'

14. The standard spacing of framing members is

    a) 12"
    b) 14"
    c) 16"
    d) 18"
    e) 20"

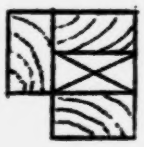
15. Cross bridging should

    a) be installed before the rough floor is laid
    b) not be nailed on the bottom until after the finish floor is laid
    c) stiffen the floor
    d) A and C
    e) A and B and C

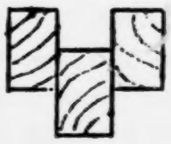
16. Which of the following sectional views represent corner posts used in rough framing for house construction? All material represented is 2 x 4 stock.

    a) X
    b) Y
    c) Z
    d) X and Y
    e) X and Y and Z

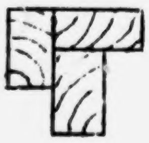
X



Y



Z



17. The most accurate device for locating all the stud positions along a house sidewall is a

    a) carpenter's square
    b) six foot folding rule
    c) 50' steel tape
    d) yard stick
    e) six foot steel tape

18. Four inch cast iron pipe is manufactured in lengths of

    a) three feet
    b) four feet
    c) five feet
    d) six feet
    e) eight feet

19. The enlarged end of a soil pipe is called a

    a) barrel
    b) hub
    c) spigot
    d) funnel
    e) none of these

20. In pouring lead into a cast iron pipe joint, all moisture must first be wiped off to prevent

    a) early rusting
    b) an explosion
    c) deterioration of the oakum
    d) the lead running through the joint
    e) too rapid cooling of the lead

21. Joint compound is applied to threaded pipe joints to

    a) prevent rust
    b) lubricate the threads
    c) prevent leaks
    d) A and B
    e) A and B and C

22. Given a grade of 1/4" per eight feet, the total grade for a drainage trench that is 100' long would be

    a) 5 1/8"
    b) 4 3/8"
    c) 2 7/8"
    d) 3 1/8"
    e) none of these

23. When placing a new washer in a leaky faucet, the first step after shutting off the water supply is to

    a) remove the faucet handle
    b) loosen the packing nut
    c) turn the faucet handle to "on" position
    d) drain the plumbing system at its lowest point
    e) select the correct size replacement washer

24. Reaming galvanized pipe during the thread cutting operation tends to

    a) restore the pipe to its original diameter
    b) make the thread die easier to start on the end of the pipe
    c) clean the end of the pipe so it is not as easy for foreign objects to lodge there
    d) A and B and C
    e) A and C

25. Before the prime coat of paint is applied, new woodwork around an entrance way to a house should

    a) be sanded
    b) have knots shellacked
    c) have the nails set
    d) A and C
    e) A and B and C

26. As a part of the process of rough wiring, a knock-out plug should be removed from an outlet box

    a) just prior to mounting the box
    b) just after mounting the box
    c) just prior to placing the cable in the box
    d) A or B
    e) B or C

27. Entrance cable should be cut with

    a) wire cutters
    b) hack saw
    c) aviation snips
    d) straight snips
    e) C or D

28. The purpose of grounding portable electric tools is to prevent injury if

    a) the operator is in contact with the ground
    b) a conductor inside the tool touches the housing of the tool
    c) the extension cord is not heavy enough for the load
    d) a fuse too small for the tool is used
    e) C or D

29. The National Electrical Code will not permit wire for regular circuits in a home to be smaller than

    a) 10 gauge
    b) 12 gauge
    c) 14 gauge
    d) 16 gauge
    e) 18 gauge

30. Solder used for electrical purposes should be

    a) rosin core
    b) acid core
    c) solid wire
    d) A or C
    e) A or B

31. The bottom and top of formwork is held securely in place by

    a) rods and spreaders
    b) bolts and cleats
    c) stakes and bracing
    d) twisted wire
    e) A and D

32. A concrete mix for ordinary foundation conditions is

    a) 2-3-4
    b) 1-2-4
    c) 1-2-2
    d) 1-3-6
    e) 1-3-1

33. In preparing material for mixing concrete on the job, the material which should be nearest the mixer operator when he is in position to feed the machine is

    a) sand and stone
    b) water
    c) cement
    d) A and C
    e) each of these has equal importance in being closest to the operator

34. The ingredient whose proportion in the mix is most important to the quality of the concrete is

    a) water
    b) cement
    c) sand
    d) stone
    e) lime

Appendix A, continued

35. A cubic foot of concrete is heavier than a cubic foot of

    a) water
    b) sand
    c) stone
    d) cement
    e) any of these

36. Freshly poured concrete may be covered to prevent damage from the

    a) sun
    b) wind
    c) rain
    d) cold
    e) all of these

37. Wood scaffolding gets its stability from

    a) bracing
    b) the building it serves
    c) the grade of lumber used
    d) A and B and C
    e) A and B

38. Tuck pointing would be done by a

    a) painter
    b) glazier
    c) mason
    d) carpenter
    e) none of these

39. The amount of waterproof coating, which covers 75 sq. ft. per quart, that is needed to treat a concrete slab 19' x 27' is

    a) 1 gal. and 1 qt.
    b) 6 qts.
    c) 4 qts.
    d) 7 qts.
    e) none of these

40. Asphalt waterproofing is most effective on a concrete block wall when it is applied to

    a) the same side of the wall from which the moisture approaches
    b) the opposite side of the wall from which the moisture approaches
    c) a parged surface
    d) A and C
    e) B and C

41. Vibrating the concrete after it is poured in a form

    a) eliminates air pockets
    b) gives a better bond on reinforcing rod
    c) produces a stronger product
    d) A and C
    e) all of these

42. A screed is used for

    a) bracing a form
    b) measuring ingredients for mixing concrete
    c) placing a final finish on a concrete slab
    d) leveling freshly poured concrete
    e) holding reinforcing rod in place in a form

43. For a guide in laying concrete block between corners in stretcher courses the mason needs

    a) a line
    b) a square
    c) a ruler
    d) A and B
    e) A and B and C

44. The cement-sand proportion for brickwork mortar is

    a) 2-4
    b) 1-4
    c) 1-3
    d) 3-3
    e) none of these

45. The least expensive way to obtain additional training in the construction trades following graduation from high school would be through

    a) on-the-job training with a non-union contractor
    b) a correspondence course
    c) an apprenticeship program sponsored by a union
    d) attendance at a junior college or community college
    e) B or C

46. Wiring used in interior residential use is usually

    a) non-metallic sheathed cable
    b) armored cable
    c) enclosed in thin-wall conduit
    d) made up of three conductors
    e) none of these

47. The switches required for wiring a light with two point control are known as

    a) single pole switches
    b) double pole switches
    c) two-way switches
    d) three-way switches
    e) toggle switches

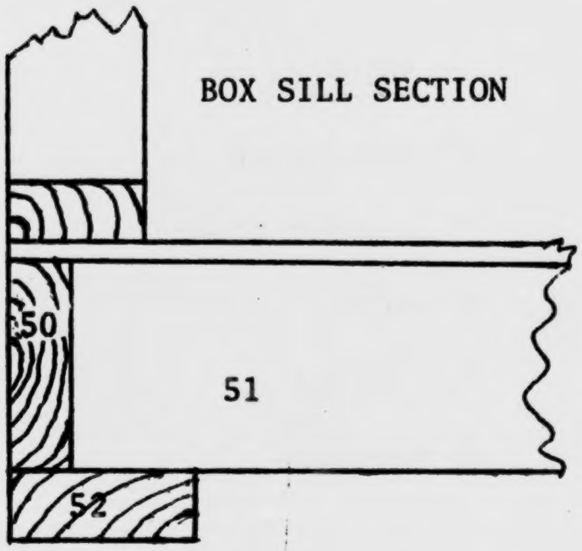
48. A brick wall may be pointed up to improve its

    a) appearance
    b) weather resistance
    c) strength
    d) A and B
    e) A,B and C

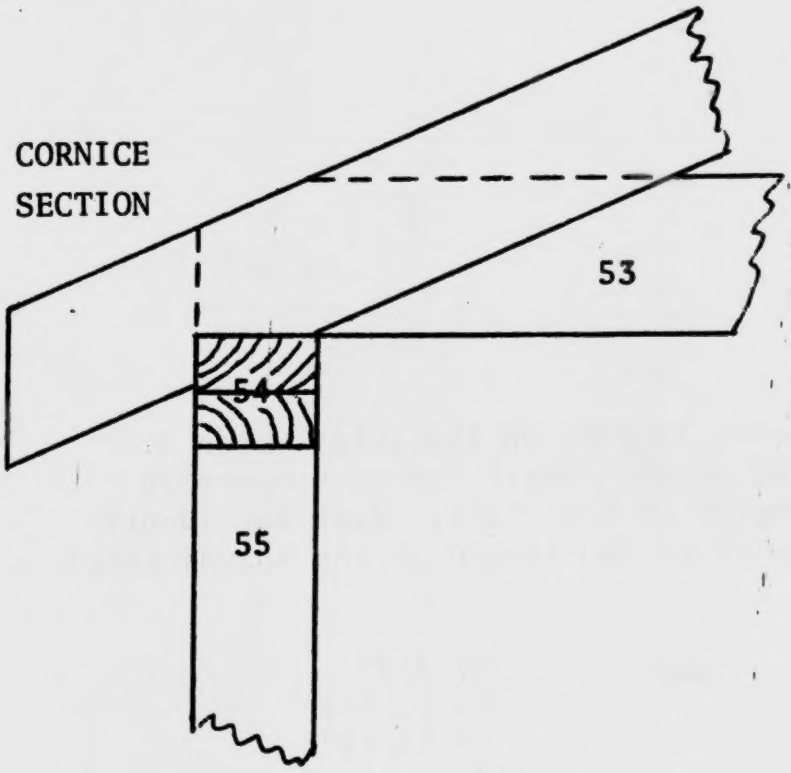
49. In order to make the old putty easy to remove when replacing a broken window pane, a putty softener makes use of

    a) heat
    b) solvent
    c) pressure
    d) impact
    e) B and C

You are to identify the numbered parts of the sectional views which are illustrated below. Select the proper name for each numbered part from the list of parts on the right of each sectional view. Mark the identifying letter opposite the number of the part on the answer sheet.



a) sole plate
b) sill
c) floor joist
d) girder
e) header



a) fascia
b) stud
c) ceiling joist
d) rafter
e) plate

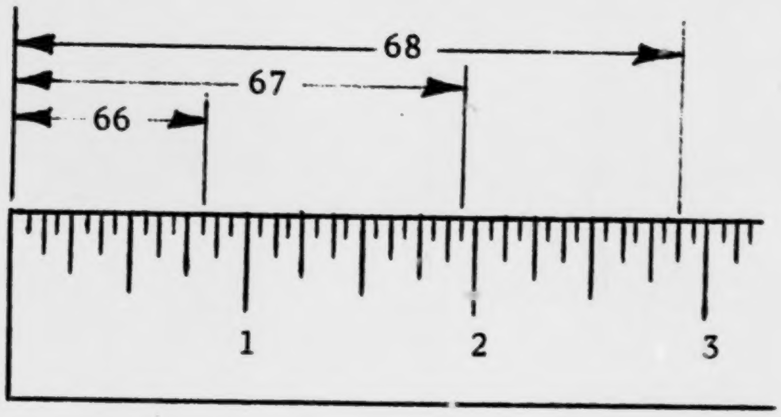
You are to identify the best thinner for each of the numbered finishes or finishing materials which are listed below. Select the proper thinner for each numbered finish or finishing material from the list of solvents on the right. Mark the identifying letter opposite the number of the finish or finishing material on the answer sheet. A thinner may be used for more than one finish.

56. latex base paint
57. enamel
58. deft
59. spar varnish
60. epoxy enamel
61. oil stain
62. paste wood filler
63. aluminum paint
64. rust inhibitive primer
65. shellac

Solvents

a) turpentine
b) lacquer thinner
c) water
d) alcohol
e) kerosene

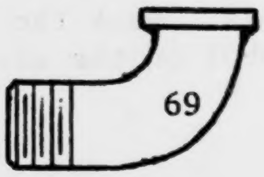
You are to identify the numbered lengths on the ruler which are illustrated below. Select the proper length for each numbered distance from the list of lengths on the right. Mark the identifying letter opposite the number of the length on the answer sheet.

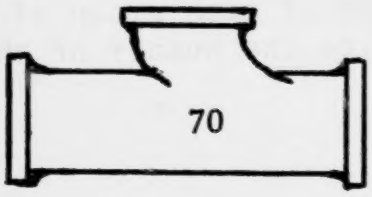


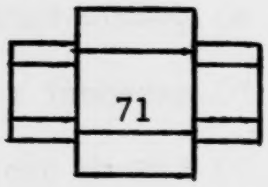
a) 3/4"
b) 1 15/16"
c) 13/16"
d) 2 5/16"
e) 2 7/8"

You are to identify the numbered illustrations which are listed below. Select the proper name for each numbered illustration from the list of names on the right of each group of illustrations. Mark the identifying letter opposite the number of the illustration on the answer sheet.

PLUMBING FITTINGS

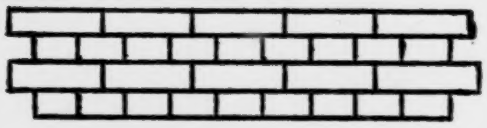


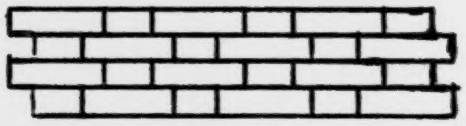


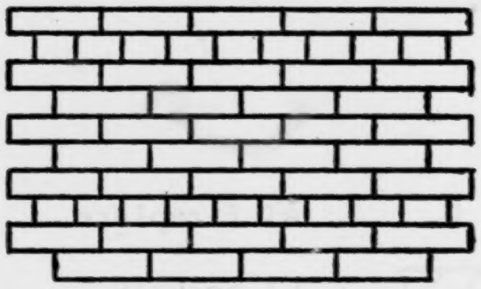


a) elbow
b) union
c) coupling
d) street elbow
e) sanitary tee

BRICK BONDS

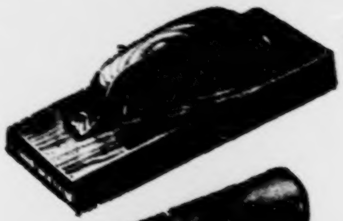

72

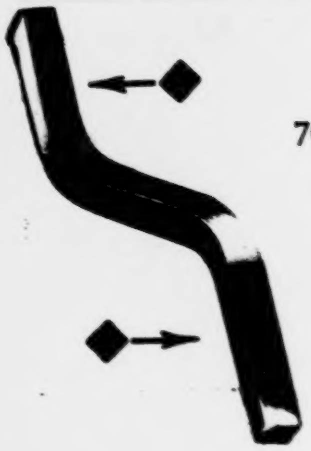

73

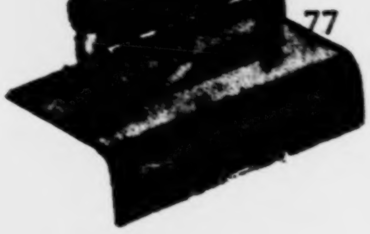

74

a) common
b) running
c) Flemish
d) English
e) basket weave

MASONRY TOOLS


75

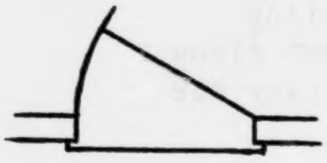

76



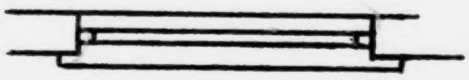
a) float
b) smoothing trowel
c) jointer
d) edger
e) hawk

Appendix A, continued

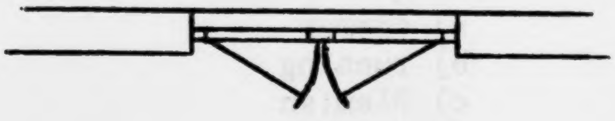
You are to identify the numbered symbols that are illustrated on the next three exercises which would be found on floor plans for a house. Select the proper name for each numbered symbol from the list of names on the right of each group of symbols. Mark the identifying letter opposite the number of the symbol on the answer sheet.



78

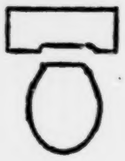


79

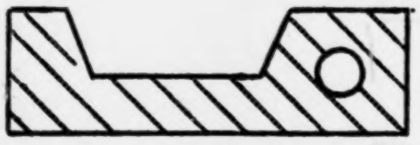


80

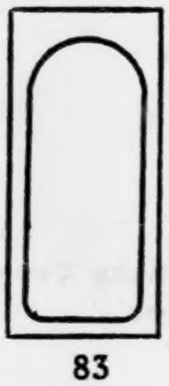
- a) double-hung window
- b) casement window
- c) French door
- d) interior door
- e) exterior door



81

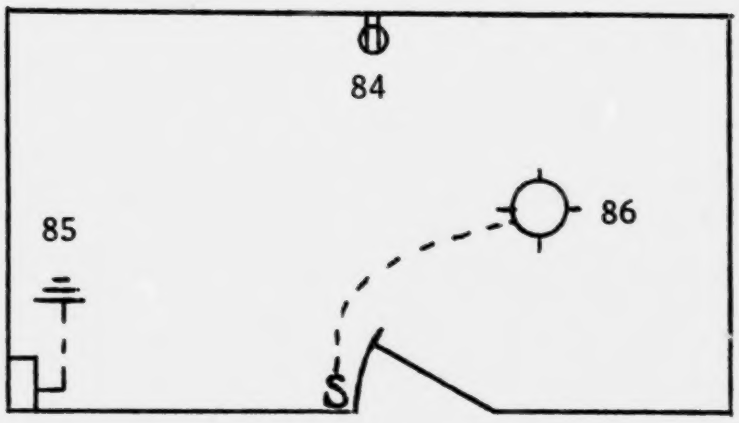


82



83

- a) fireplace
- b) archway
- c) water closet
- d) footing
- e) bathtub



a) ground

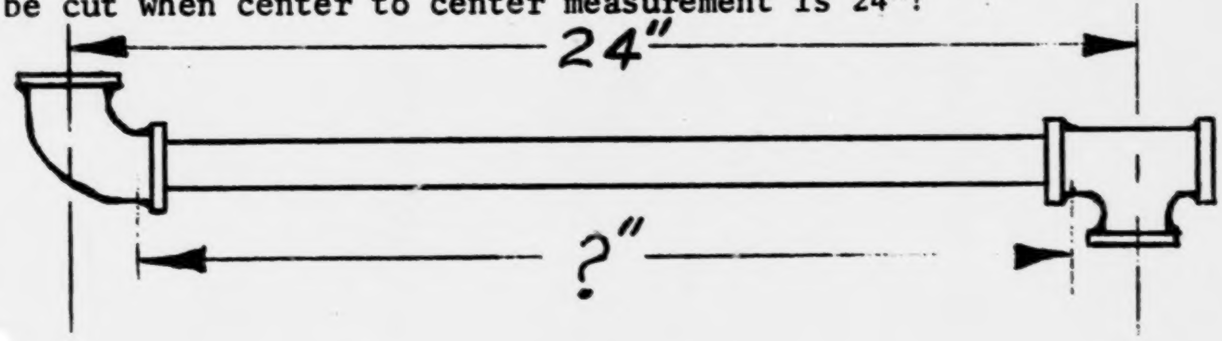
b) receptacle

c) ceiling fixture

d) range receptacle

e) conductor

87. Given center to end dimension for a 1 1/4" T as 1 3/4" and center to end dimension for a 1 1/4" 90° Elbow as 1 3/4" and normal thread engagement for 1 1/4" pipe as 11/16". How long must a piece of pipe be cut when center to center measurement is 24"?



a) 22 1/2

b) 23 5/8

c) 25

d) 21 3/16

e) 22 5/16

ACHIEVEMENT TEST

METAL FORMING AND FABRICATION CLUSTER

Do not open this booklet until you are told to do so.

On your SEPARATE ANSWER SHEET print your name, address, and other requested information in the proper spaces then wait for further instructions.

DO NOT MAKE ANY MARKS IN THIS BOOKLET

Cluster Concept Program
Industrial Education

Appendix A, continued

Each of the questions or incomplete statements listed below is followed by several possible answers. Choose the answer that best answers the question or completes the statement. Fill in the correct space on your separate answer sheet (A,B,C OR D). Make certain the number of the question corresponds with the number you are filling in on your answer sheet. MARK ALL ANSWERS WITH A SOFT PENCIL - FILL IN THE SPACE COMPLETELY.

MACHINING

1. An engine lathe with a four-step cone pulley and back gears has

    a) four spindle speeds
    b) as high as 24 spindle speeds
    c) eight spindle speeds

2. More torque and slower speed are obtained on the lathe by using

    a) reversing gears
    b) back gears
    c) apron gears
    d) headstock gears

3. An accurate way to find out how much stock must be removed in finish turning is to use

    a) a caliper
    b) dividers
    c) micrometer
    d) a surface height gauge

4. To adjust for different thickness of work pieces on the shaper

    a) swivel the vise
    b) adjust the length of the stroke
    c) adjust the table up or down
    d) use a different tool holder

5. The most common method of holding the work in a milling machine is with

    a) a chuck
    b) a swivel vise
    c) a dividing head
    d) strap clamps

6. What is meant by structure of a grinding wheel

    a) kind of abrasive
    b) size of abrasive particles
    c) arrangement of abrasive particles
    d) amount of bond

7. Which of the following methods is not commonly used for holding work on a milling machine

   a) clamps
   b) vises
   c) magnetic chuck
   d) dividing head

8. What instrument is best suited for testing and setting the vise jaws in relation to the milling machine spindle

   a) combination square
   b) solid square
   c) parallels
   d) dial indicator

9. Which of the following are not important factors affecting the efficient operation of the shaper

   a) setting the length of the stroke
   b) size of the table
   c) setting the position of the stroke
   d) clamping of the work

10. In the metal working shop a rule is used for

    a) precision measurement
    b) angular measurement
    c) semi-precision measurement
    d) rapid calculations

11. Which of these is not a principal method of shaping metal

    a) drilling
    b) grinding
    c) milling
    d) sawing

12. The successful action of a cutting tool depends primarily upon

    a) speed
    b) feed
    c) depth of cut
    d) all of these

13. To measure accurately any piece of work, the micrometer should first be opened larger than the object to be measured, then screwed down on the object until the end of the ______ and ______ are in contact with the object.

    a) barrel and thimble
    b) spindle and anvil
    c) frame and spindle
    d) thimble and anvil

14. The sum of .375 and .4375 is

    a) .5000
    b) .625
    c) .8125
    d) .7925

15. The sum of .250 and .21875 is

    a) .46875
    b) .48675
    c) .3175
    d) .64785

16. The difference between .3125 and .250 is

    a) .625
    b) .5625
    c) .0625
    d) .00625

17. The difference between .4375 and .1875 is

    a) .6150
    b) .025
    c) .250
    d) .052

SHEET METAL

18. Solder is made of

    a) lead and zinc
    b) tin and zinc
    c) babbit and lead
    d) lead and tin

19. Copper is distinguished by a color of

    a) reddish brown
    b) blackish green
    c) yellow gold
    d) silver (dull)

20. When drilling holes in sheet metal the metal is best secured by

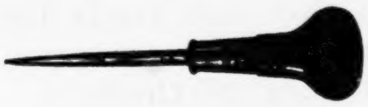
    a) a "C" clamp
    b) a vise
    c) "V" blocks
    d) screws

21. A groover is used for

    a) aligning edges
    b) completing a seam
    c) making a cap strip seam
    d) cutting a channel in steel

22. This tool illustrated is used in the metal shop for

    a) punching holes in metal
    b) general purpose scribing on metal
    c) seaming sheet metal
    d) making templates

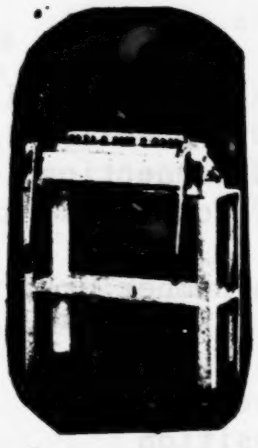


23. Metal patterns that are used repeatedly are called

    a) metal patterns
    b) templates
    c) copy plates
    d) scribe plates

24. The process of joining sheet metal parts together with liquid metal and heat is

    a) heat treating
    b) glueing
    c) soldering
    d) casting



25. This machine is used to

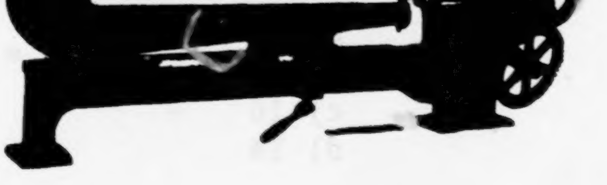
    a) bend sheet metal
    b) fold sheet metal
    c) seam sheet metal
    d) all of these

26. Which of these instruments is used to measure the thickness of sheet metal

    a) rule
    b) sheet metal gauge
    c) calipers
    d) combination square

27. One purpose of this machine is to

    a) bend metal
    b) hold metal for clamping
    c) cut sheet metal disks
    d) make double seams with sheet metal



28. Which of the following is not a holding device

    a) vises
    b) rivet set
    c) spring clamps
    d) parallel clamps

29. What does the following have in common, standing, grooved, cap strip and Pittsburg

    a) they are names of seams used to join sheet metal parts
    b) they are tools used in working sheet metal
    c) they are rollers used for shaping sheet metal parts
    d) none of these

WELDING

30. Which of the following is not a weld joint

    a) butt
    b) lap
    c) cross
    d) tee

31. When the polarity is straight

    a) the ground connection is positive and the electrode is negative
    b) the ground connection is negative and the electrode is positive
    c) the ground connection is negative and so is the electrode
    d) the ground connection and the electrode are positive

32. The letter and each number used to classify welding electrodes have a specific meaning. Which of the following is not a specific meaning

    a) electric welding
    b) welding position
    c) insulation for electrode holder
    d) tensile strength

33. When the stock being arc welded is covered with weld spatter

    a) the arc is not bright enough
    b) the electrode is held too far away from the work
    c) the amperage setting on the generator is too low
    d) the electrode is too large for the required welding

34. The shade of helmet glass commonly used in arc welding is number

    a) 3
    b) 25
    c) 10
    d) 14

35. The two gases most commonly used in flame welding are

    a) oxygen-acetylene
    b) acetylene-carbon dioxide
    c) iron oxide-oxygen
    d) hydrogen-nitrogen

36. Metals are divided into two major families

    a) hard and soft
    b) combustible and non-combustible
    c) ferrous and non-ferrous
    d) iron and steel

37. The welding arc may be started by

    a) tapping
    b) scratching
    c) a and b
    d) striking

38. Gas welding equipment may be used for

    a) cutting metals
    b) welding metals
    c) brazing metals
    d) all of these

39. To secure a weld that has proper penetration the welder must have

    a) correct electrode
    b) correct arc length
    c) correct current and travel speed
    d) all of these

40. Of the many methods of welding in use today which dominates the field

    a) gas
    b) arc and resistance
    c) a and b
    d) low carbon

41. Resistance welding is a process of

    a) fusing metals together by heat and pressure
    b) gas-shielded arc welding
    c) fusing metals together with heat obtained from the combination of gases
    d) welding with an overhead electrode made of mild steel

Appendix A, continued

ASSEMBLY

42. Hand application of adhesives in assembly depends upon proper

a) bond development
b) surface preparation
c) assembly
d) all of these and more

43. The most important factor in bonding metal parts with an adhesvies is

a) reading and following manufacturer's instructions
b) applying knowledge of weight and volume for mixing adhesives
c) setting up the metal assembly
d) cleaning surfaces to be bonded

44. Which of the following has no relationship to applying adhesives

a) spatula rake
b) spray gun
c) chemical bath
d) brush

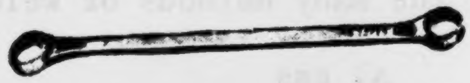
45. Match the following tools with the screws to the right

1. _____ screwdriver
46. 2. _____ allen wrench
47. 3. _____ phillips head screwdriver

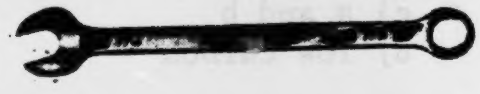
a) set screw
b) phillips head screw
c) eyelet screw
d) stove bolt
e) flat, round, and oval wood screws

48. Which of the following wrenches cannot be used to bolt metal parts together

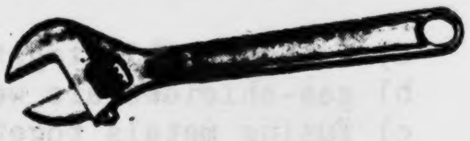
a)



b)



c)



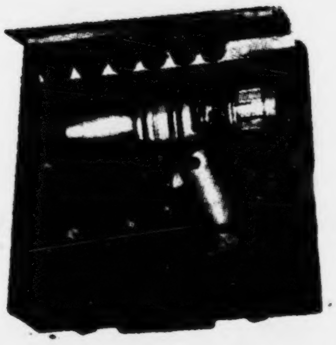
d)

49. With which activity are the following tools associated

- a) welding metal parts together
- b) screwing metal parts together
- c) riveting metal parts together
- d) bolting metal parts together

50. This tool is called

- a) an electric drill
- b) an impact wrench
- c) a soldering gun
- d) a power timing wrench



51. The tool in question #50 above is used primarily in

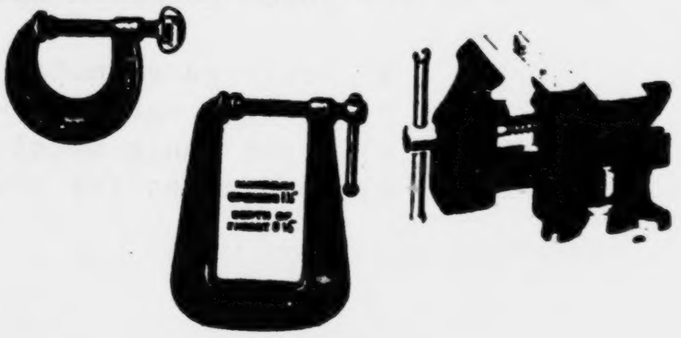
- a) foundry work
- b) electrical installations
- c) assembly line work
- d) construction work

52. The most important part of mating parts together to produce sub-assemblies is

- a) aligning mated parts for assembly with an aligning punch
- b) selecting parts for the sub-assembly
- c) mating delicate parts with care
- d) reading blueprints (exploded view drawings) to determine relationship of detail parts to be mated.

53. What would the following holding devices best be used for

- a) holding parts for cutting
- b) holding parts for assembly
- c) holding parts for cleaning
- d) all of these



Appendix A, continued

GENERAL

54. The terms flat, cape, roundnose, and diamond point are names for

a) rivets
b) bolt cutters
c) cold chisels
d) metal screws

55. Files are named for their

a) shapes
b) abrasiveness
c) use
d) all of these

56. Drill sizes may be given in

a) letters
b) numbers
c) both a and b
d) none of these

57. The angle of a metal countersink may be as great as

a) 120°
b) 90°
c) 150°
d) 60°

58. Tapping in metal work means to

a) produce a threaded pipe
b) produce a threaded hole
c) pour molten metal
d) punch holes for riveting

59. In metal working the most widely used coolant is a combination of

a) water and alcohol
b) water soluble oil and water
c) machine oil and turpentine
d) alcohol and oil

60. A hollow punch is often used to punch holes in

a) heavy gauge metal
b) plastic material with metal-like qualities
c) light gauge metal
d) lead cakes for riveting

61. To thread a hole the metal worker should use a

- a) die
- b) tap
- c) screw thread
- d) pipe threader

62. For precision measurements the metal worker should use

- a) a sheet metal gauge
- b) a ruler
- c) a micrometer
- d) an adapter gauge

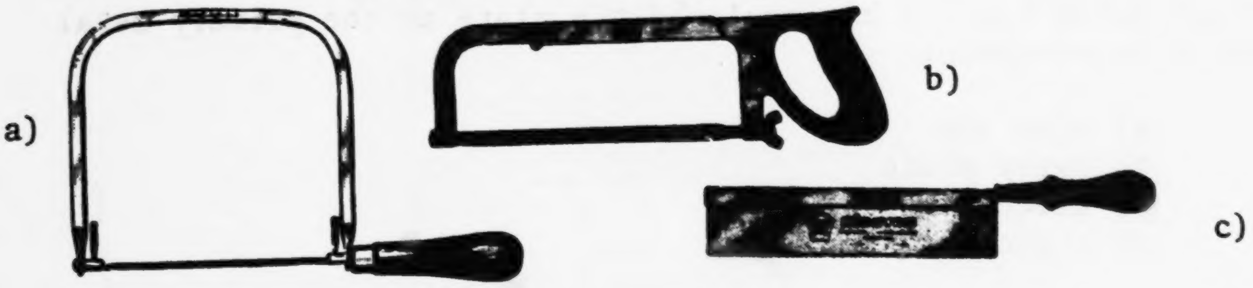
63. The hammer used most often by the metal worker is the

- a) paring hammer
- b) ball peen hammer
- c) claw hammer
- d) mallet

64. When a tube is flared

- a) one end is made larger
- b) one end is made smaller
- c) it is cut down the center with a flaring tool
- d) the inside is made larger

65. Which of these saws is best for cutting metal



66. The tools most commonly used in layout are

- a) ordinary and combination squares
- b) dividers, center punch, and scratch awl
- c) micrometers and circumference rule
- d) both b and c

67. Since lines scribed on many metals are difficult to see, such surfaces are coated with

    a) a copper sulfate solution
    b) a white wash solution
    c) layout fluids
    d) a, b, or c

68. In order for the metal worker to work to dimensions it is necessary that the metal be

    a) laid out
    b) heat treated
    c) malleable
    d) measured

69. Galvanized sheet metal consists of

    a) heavy steel sheets coated with lead
    b) soft steel sheets coated with zinc
    c) iron or steel sheets coated with pure tin
    d) steel sheets coated with black iron

70. When making reference to alloys the letter "O" means

    a) work-hardened
    b) heat treated
    c) annealed
    d) kind of metal

71. Which metal has all but replaced tin plate as the primary metal in dairy equipment

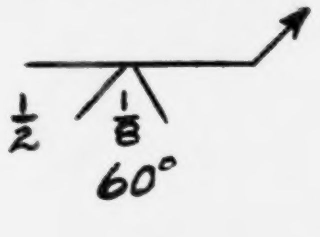
    a) aluminum
    b) dairy plate
    c) charcoal plate
    d) stainless steel

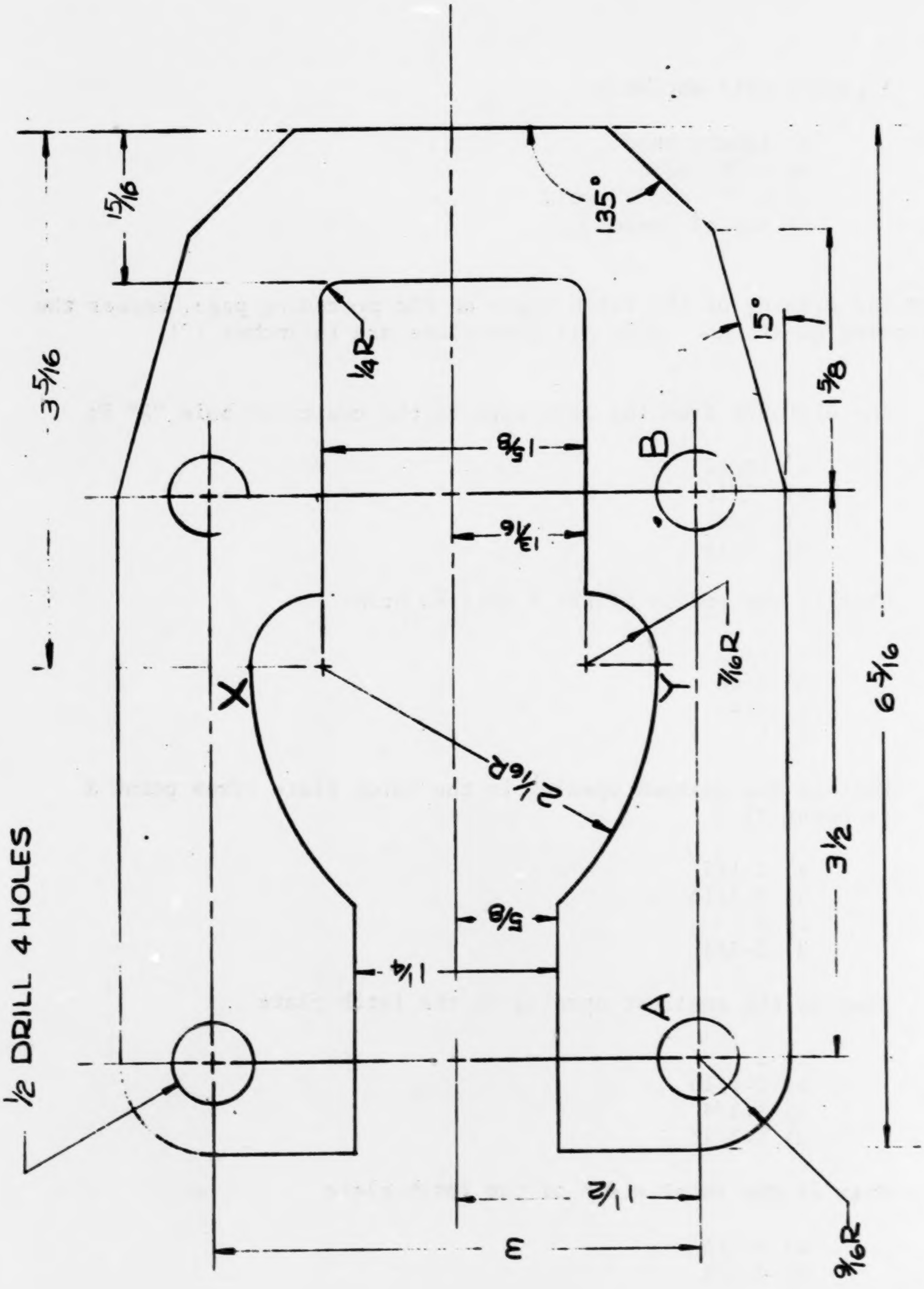
72. When metal is annealed it is

    a) hardened
    b) softened
    c) coated with another metal
    d) none of these

73. The weld symbol to the right represents which type of weld

    a) fillet
    b) groove
    c) back
    d) plug




15/16
135°
15°
1 5/8
3 5/16
1/4R
1 5/8
B
13/16
7/16R
6 5/16
X
Y
2 1/16R
3 1/2
5/8
1 1/4
A
1/2 DRILL 4 HOLES
1 1/2
3
9/16R

LATCH PLATE

74. A groove weld may be a

a) square weld
b) a "V" weld
c) a "U" or "J" weld
d) any of these

From the drawing of the latch plate on the preceding page, answer the following questions. NOTE all dimensions are in inches (").

75. The distance from the left edge to the center of hole "A" is

a) 19/32
b) 7/16
c) 1/2
d) 9/16

76. What is the radius of the 4 drilled holes

a) 1/2
b) 3/16
c) 1/4
d) 1

77. What is the maximum opening in the latch plate (from point X to point Y)

a) 2-1/2
b) 2-1/16
c) 3
d) 2-3/4

78. What is the smallest opening in the latch plate

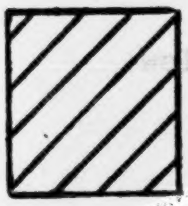
a) 2
b) 1-1/16
c) 1-1/4
d) 1-3/16

79. What is the total width of the latch plate

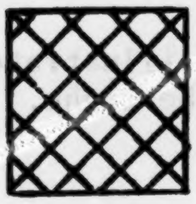
a) 4-1/8
b) 4-3/8
c) 4-3/16
d) 4

80. What is the distance between centers of holes "A" and "B"

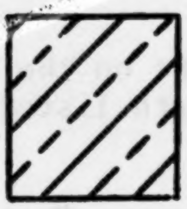
a) 4-1/2
b) 3-1/2
c) 3-3/4
d) 4-1/8



1



2



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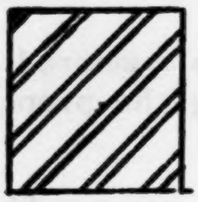

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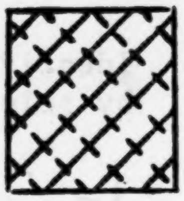


5

81. Which of the material symbols shown above is used for steel?

a) 1
b) 2
c) 3
d) 4
e) 5

82. Which of the material symbols shown above is used for cast iron?

a) 1
b) 2
c) 3
d) 4
e) 5

83. Which of the material symbols shown above is used for aluminum?

a) 1
b) 2
c) 3
d) 4
e) 5

84. What is the name given to the drawings above?

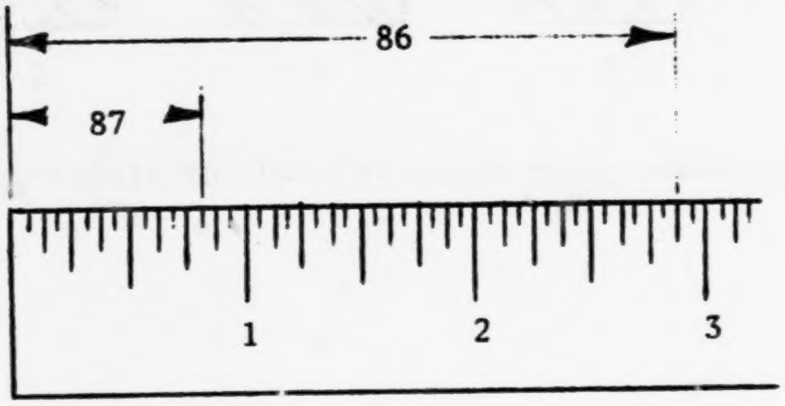
a) orthographic projection
b) sectional
c) working drawings
d) dimensioning

85. One of the most valuable skills you can acquire in metal work is

a) how to read the circumference rule
b) the formation of a positive safety attitude
c) expertness in the use of the milling machine
d) how to read the metal gage

Appendix A, continued

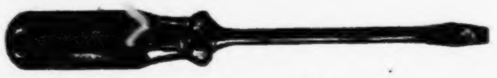
Identify the numbered lengths on the ruler illustrated below by selecting the proper length listed on the right.

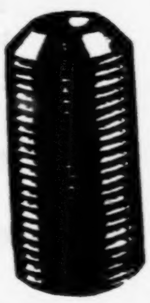


a) 3/4"
b) 1 15/16"
c) 13/16"
d) 2 5/16"
e) 2 7/8"

Match the tool on the left with its proper fastener on the right.

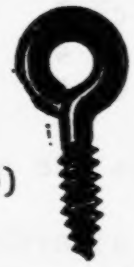
88.



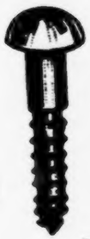


a)

89.

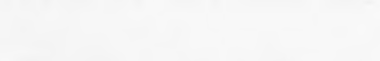


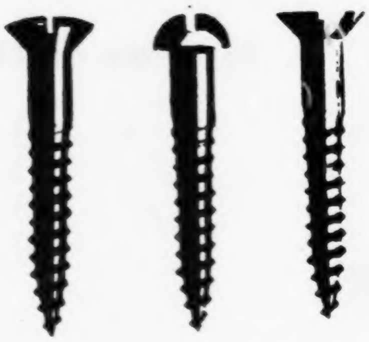
b)



c)

90.





d)

ACHIEVEMENT TEST

ELECTRO-MECHANICAL INSTALLATION AND REPAIR CLUSTER

Do not open this booklet until you are told to do so.

On your SEPARATE ANSWER SHEET print your name, address, and other requested information in the proper spaces then wait for further instructions.

DO NOT MAKE ANY MARKS IN THIS BOOKLET

Cluster Concept Program

Industrial Education

Each of the questions or incomplete statements listed below is followed by several possible answers. Choose the answer that best answers the question or completes the statement. Fill in the correct space on your separate answer sheet (A,B,C,D, OR E). Make certain the number of the question corresponds with the number you are filling in on your answer sheet. MARK ALL ANSWERS WITH A SOFT PENCIL - FILL IN THE SPACE COMPLETELY.

APPLIANCE SERVICING

1. A good conductor

   a) has a lot of planetary electrons
   b) has a lot of free electrons
   c) is always a compound
   d) will permit electrons to flow through it easily

2. Some examples of good insulators are

   a) silver, copper, gold, and aluminum
   b) glass, mica, wood, plastic, procelain, rubber
   c) salt water, steel, tungsten
   d) none of the above

3. Electromotive force is

   a) measured in watts
   b) measured in ohms
   c) measured in amperes
   d) measured in volts

4. An ampere is

   a) the unit of potential difference
   b) one coulomb of electrons per second
   c) the unit of rate, or intensity, of current flow
   d) the unit of resistance

5. An ohm is

   a) one millionth of a megohm
   b) 1,000 milliohms
   c) the unit of resistance
   d) the unit of conductance

6. How many amperes will a roaster that has a resistance of 15 ohms and is connected to a 120 volt power source draw?

   a) 8
   b) 12
   c) 16
   d) 20

7. Assuming there is no change in resistance due to heat, a device that has a resistance of 22 ohms and is rated to draw 10 amperes must be connected to a source of power rated at how many volts?

    a) 110
    b) 115
    c) 210
    d) 220

8. A device that draws 6 amps from a 120 volt source has a resistance of how many ohms?

    a) 20
    b) 30
    c) 40
    d) 50

9. A circuit that is not complete is called
    a) a short circuit
    b) an open circuit
    c) a grounded circuit
    d) a series circuit

10. If both sides of the circuit touch each other

    a) it is called a short circuit
    b) you would get a shock if you touched the device
    c) it would blow a fuse
    d) the resistance of the circuit would increase

11. If you get a shock when you touch the frame of a device, the device

    a) has a short
    b) is grounded
    c) is open
    d) will not operate

12. If one device of many in a series circuit becomes shorted

    a) none of the devices will work
    b) the shorted device is the only one that will have a voltage drop across it
    c) each of the other devices will have more current than normal
    d) each of the other devices will have more voltage drop than normal

13. A tramsformer that has a single tapped coil is called

    a) an isolation transformer
    b) an autotransformer
    c) a ballast
    d) a step-down transformer

14. A group of copper bars embedded in a laminated iron cylinder and shorted together at each end with a copper or aluminum ring is called a

    a) universal armature
    b) field winding
    c) squirrel cage rotor
    d) single phase armature

15. A tap is used for

    a) threading a bolt
    b) drilling a hole
    c) threading a hole
    d) tightening a bolt

16. The device used to turn down commutators is an

    a) arbor press
    b) bench vice
    c) pedestal grinder
    d) metal lathe

17. If you must work on any electrical equipment when moisture is present, and the equipment must remain energized, what should you do

    a) stand on a good insulator
    b) use insulated tools
    c) wear insulated gloves
    d) all of the above

18. If the points on a switch controlling a circuit become shorted

    a) nothing will work in the circuit
    b) the circuit cannot be turned off
    c) the circuit cannot be turned on
    d) the resistance of the circuit will be reduced

19. If one of the branches of a parallel circuit becomes shorted

    a) it will blow a fuse
    b) the circuit resistance will be reduced to zero
    c) the short would have to be located with a self-powered test instrument
    d) no current will flow through the good devices

20. The type of motor used in a kitchen blender is

    a) shaded-pole motor
    b) universal motor
    c) smaller motor than a mixer
    d) larger motor than a mixer

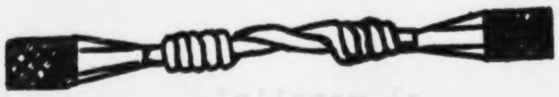
21. Electric mixers usually

    a) use the governor type of speed control
    b) have less different speeds than the blender
    c) use the tapped-field method of speed control
    d) use the adjustable brush method of speed control

22. If the motor runs jerkily in a series of spurts, the trouble may be

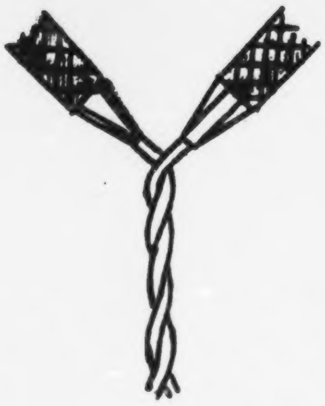
    a) shorted capacitor
    b) open speed control resistor
    c) speed control set too low
    d) points welded together

23. Idenfity the following types of splices



a) Knotted tap splice
b) Western Union splice
c) Pigtail splice
d) Tap splice

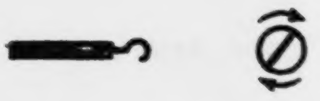
24.



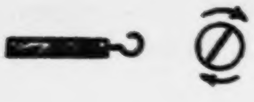
a) Pigtail splice
b) Tap splice
c) Western Union splice
d) Common Tap splice

Appendix A, continued

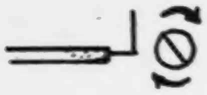
25. Which is the correct method of connecting a wire under a terminal screw?



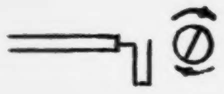
A



B

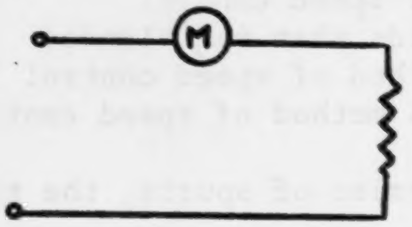


C



D

26. To measure current the meter in the diagram below is connected in



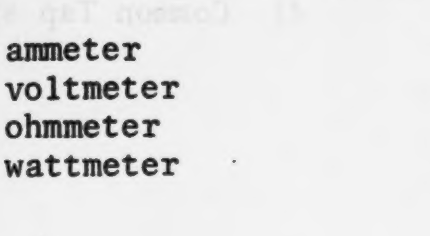
a) parallel

b) series

27. What type of meter would be used to measure current

a) ammeter
b) voltmeter
c) ohmmeter
d) watt meter

28. To measure voltage the meter in the diagram below is connected in



a) parallel

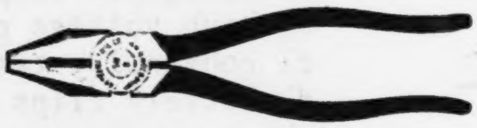
b) series

29. What type of meter would be used in the diagram above

a) ammeter
b) voltmeter
c) ohmmeter
d) wattmeter

Appendix A, continued

30.

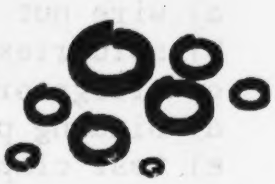


a) combination pliers
b) straight pliers
c) electricans pliers
d) diagonal cutters
e) channellock pliers

31.

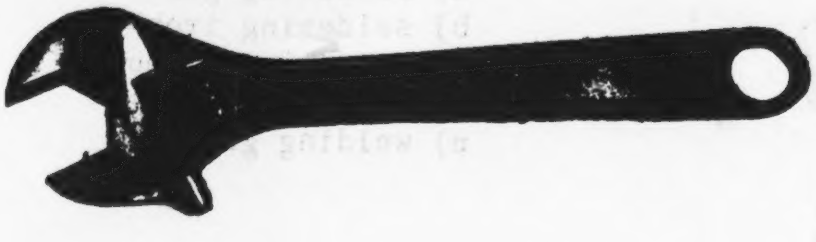
a) wood screw
b) cap screw
c) machine screw
d) stove bolt
e) sheet metal screw

32.



a) grommet
b) lock washers
c) solderless connectors
d) flat washers
e) shake washer

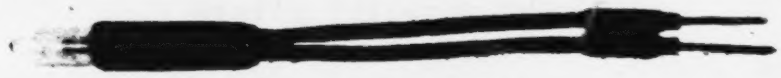
33.



a) stillson wrench
b) pipe wrench
c) torque wrench
d) adjustable wrench
e) combination wrench

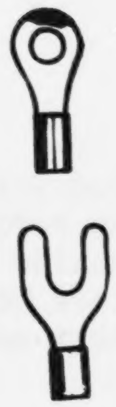
Appendix A, continued

34.



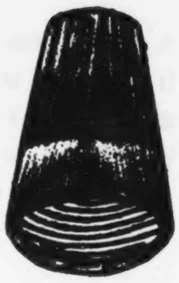
a) alligator clips
b) high voltage probe
c) continuity tester
d) battery clips
e) wire connectors

35.



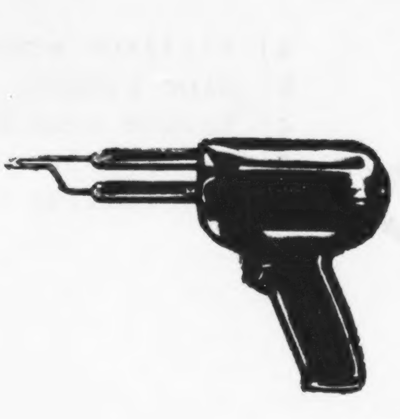
a) wire connectors
b) solderless terminals
c) battery clips
d) alligator clips
e) terminal strips

36.



a) wire nut
b) solderless terminals
c) alligator clip
d) binding post
e) test clip

37.



a) soldering gun
b) soldering iron
c) soldering copper
d) spot welder
e) welding gun

RADIO AND TELEVISION

38. A television tuner operates at frequencies

    a) the same as a superheterodine radio
    b) from 50 to 200 times higher than a broadcast radio receiver
    c) lower than a broadcast radio receiver
    d) none of the above

39. Most tuner failures are

    a) in the balum coil
    b) caused by tube failure
    c) faulty filters and traps
    d) mechanical

40. To determine if the oscillator is working

    a) check plate of oscillator with a .01 M F D capicator
    b) watch for horizontal thin lines on the raster
    c) check for a negative voltage on grid of mixer
    d) check the coupling condenser

41. To determine if the mixer is operating properly

    a) check plate voltage
    b) observe the raster for the presence of "snow"
    c) check for a lighted filament
    d) none of the above

42. A reliable method of checking the RF amplifier would be to

    a) touch or scratch the antenna terminal
    b) listen to the sound for defects
    c) check for negative voltage on test point of tuner
    d) scratch plate of oscillator

43. The key check point for the I F strip is

    a) I F filter capicator
    b) video detector load resistor
    c) 1st. I F plate voltage
    d) 2nd. or 3rd. I F plate voltage (depending on the
    number of I F circuits

44. The most likely suspect for a weak fly back pulse is a

    a) vertical output tube
    b) horizontal output tube
    c) AGC amplifier
    d) none of these

45. The key test point in troubleshooting the vertical oscillator is the

    a) coupling capacitator
    b) grid of the vibrator
    c) grid of the oscillator tube
    d) Sync output

46. The purpose of the AFC system is to

    a) provide smooth DC voltages to horizontal oscillator
    b) control feedback signal
    c) greater positive plate voltage
    d) maintain 15,750 cycles to grid of horizontal output

47. With the Sync separator tube removed and the sides of the picture crooked, trouble would be

    a) oscillator
    b) ABC
    c) video 1F
    d) flyback transformer

48. The function of the vertical sweep circuit is to

    a) operate the vertical hold control
    b) generate a 60 cycle signal that will produce a sawtooth current in the vertical deflection coils
    c) operate height control
    d) provide voltages for retrace blanking

49. In order for a tube to conduct

    a) control grid must be negative
    b) filament must reach a high temperature
    c) cathode must be positive
    d) the plate must be positive

50. Maximum brightness and minimum contrast will enable the serviceman to

    a) check the CRT
    b) see vertical retrace lines
    c) observe blanking
    d) observe syncpulses

51. The high voltage rectifier in black and white receiver has output of

    a) 12000 to 16000 volts
    b) 10,000 to 25,000
    c) 8,000 to 16,000
    d) 12,000 to 25,000

52. A circuit under test is found to have a voltage reading of 30 and a resistance of 120 ohms - the current should be

a) 2.5 amps
b) .5 amps
c) .25 amps
d) 1.5 amps

53. The boost voltage at the damper should be approximately

a) 500 V +
b) 800 V +
c) 600 V +
d) 700 V +

54. The bias voltage at the horizontal oscillator will be

a) - 2 volts
b) + 2 volts
c) - or + 2 volts
d) none of these

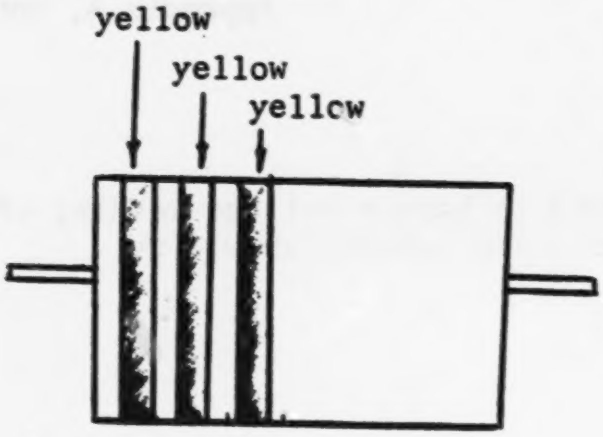
55. The bias voltage at the horizontal output will be

a) - negative
b) + positive
c) may be either + or -
d) none of the above

56. A resistor color bands of red, black, and green would have a resistance of

a) 20 ohms
b) 200 ohms
c) 200,000 ohms
d) 2 million ohms

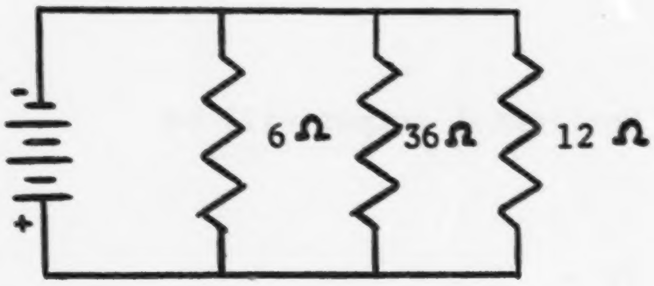
57.



The value of the resistor above is

a) 330 K ohms
b) 33 K ohms
c) 33,000 K ohms
d) K ohms

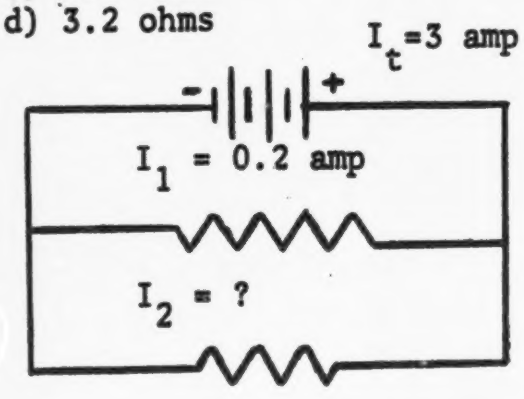
58.



The total resistance in the figure above is

a) 12 ohms
b) 6 ohms
c) 3.6 ohms
d) 3.2 ohms

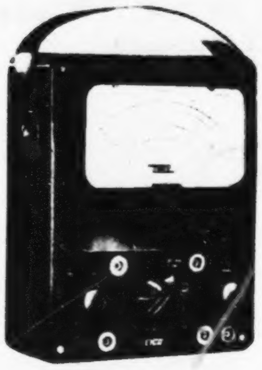
59.



In the above figure the current is

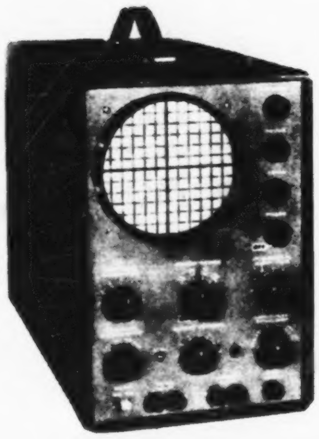
a) 0 amps
b) 4 amps
c) 8 amps
d) 0 amps

60.



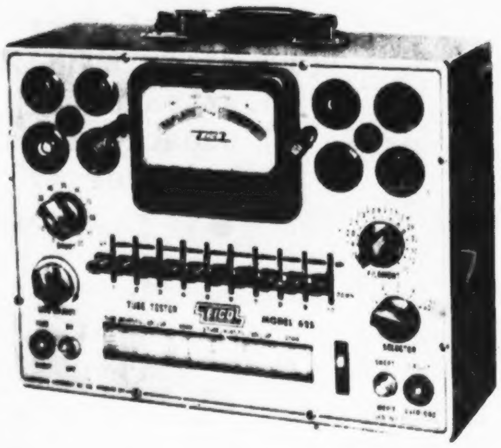
a) battery charger
b) tube tester
c) oscilloscope
d) amprobe
e) VOM

61.



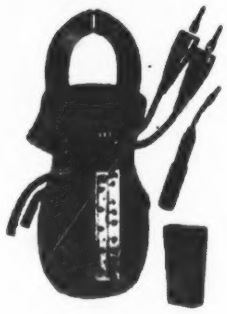
a) wheatstone bridge
b) signal generator
c) oscilloscope
d) power supply
e) multi-meter

62.



a) signal generator
b) power supply
c) oscilloscope
d) tube tester
e) amprobe

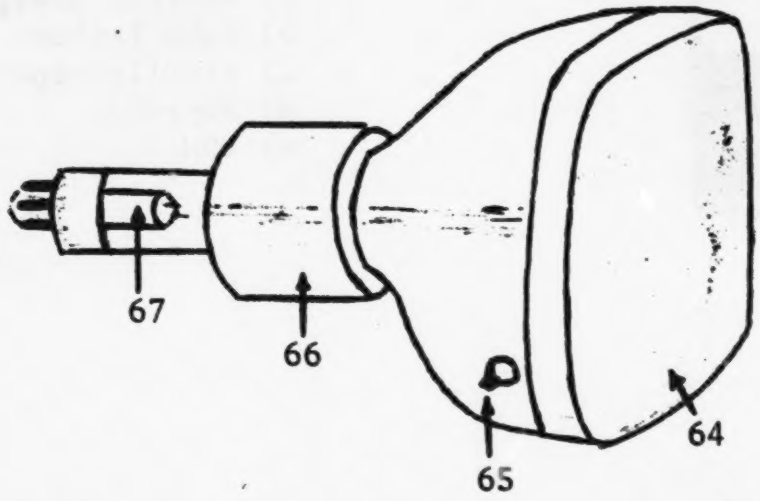
63.



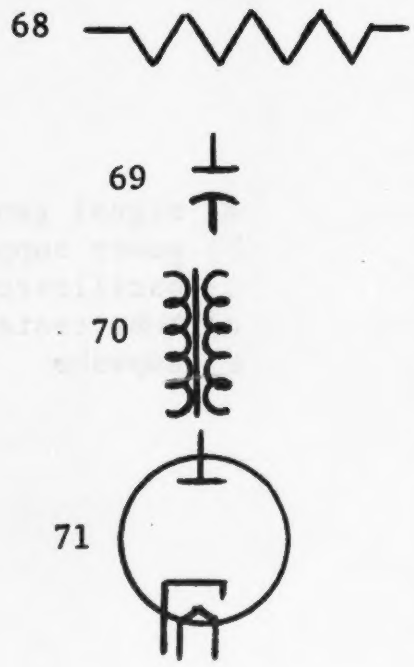
a) VOM
b) uni-probe
c) power supply
d) transitor tester
e) amprobe

Appendix A, continued

Identify the parts indicated in the picture below. Place your answer opposite the number of the part on the answer sheet.



a) CRT
b) yoke
c) electron beam
d) high voltage connection
e) raster



a) transformer
b) diode tube
c) antenna
d) capacitor
e) resistor

AIR CONDITIONING & REFRIGERATION

72. Pressure is defined as the:

    a) atmosphere
    b) weight or force per unit area
    c) volume of a gas
    d) gauge reading

73. To stop the unit from refrigerating when the desired temperature has been reached, one must provide means to:

    a) turn the thermostat warmer
    b) stop the motor
    c) defrost the cooling unit
    d) close the cabinet door.

74. The range control adjusts the:

    a) cut-out temperature
    b) cut-in temperature
    c) both cut-out and cut-in temperature
    d) differential temperature

75. Low-side floats have been discontinued on domestic refrigerators because they require

    a) too much refrigerant
    b) too much space
    c) too much space and refrigerant
    d) too much service

76. Leaks are detected in a Freon system by the use of the:

    a) soap and water test
    b) oil test
    c) ammonia swab test
    d) halide lamp test

77. The most sensitive leak detector is the

    a) halide lamp test
    b) electronic detector
    c) soap and water
    d) ammonia swab

78. The best solder for sweating copper joints is

    a) 50-50 solder
    b) resin core
    c) acid core
    d) silver solder

79. Air in the system produces a

    a) low suction pressure
    b) high suction pressure
    c) low discharge pressure
    d) high head pressure

80. Refrigerators should always be charged by adding refrigerant into the

    a) high side of the cycle
    b) low side of the cycle
    c) either side, it makes no difference
    d) compressor

81. The purpose of the condenser in the refrigeration system is to

    a) remove water
    b) maintain proper pressure
    c) prevent gas from escaping
    d) remove heat

82. Bubbles in the liquid line indicate that there is

    a) air in the system
    b) a shortage of refrigerant
    c) too much refrigerant
    d) nothing is wrong

83. Moisture in a Freon - 12 system will

    a) not harm the unit
    b) cause a refrigerant leak
    c) freeze in the refrigerant control orifice, eventually clogging it
    d) form sulphurous acid from the indoor area

84. The recommended device used to clean motor control contact points is a

    a) power grinder
    b) emery cloth
    c) oil stone
    d) fine file

85. The function of the evaporator is to

- a) reject heat from the system
- b) increase the density of the refrigerant
- c) meter the flow of refrigerant through the system
- d) absorb heat from the air or water surrounding it

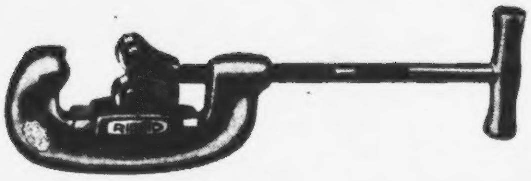
86. The hermetic compressor is normally serviced in

- a) the field
- b) the shop
- c) by replacing it
- d) with a monkey wrench and screwdriver

87. In calculating the cooling load for a residence it is necessary to determine

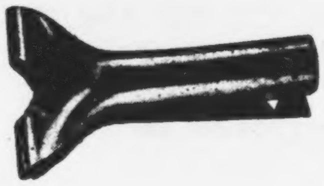
- a) the heat loss in BTU
- b) the heat gain in BTU
- c) the size of the heating plant
- d) the amount of hot water consumed per day

88.



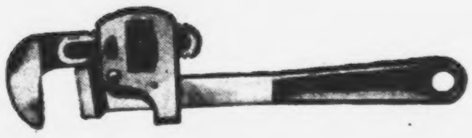
- a) conduit bender
- b) pipe cutter
- c) fuse puller
- d) wire skinner

89.



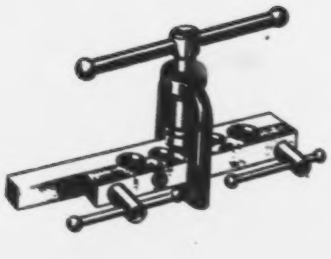
a) wire skinner
b) wire cutter
c) B-X armor cutter
d) cable ripper

90.



a) vice grips
b) box wrench
c) pipe wrench
d) adjustable wrench

91.



a) flaring tool
b) tubing bender
c) tap wrench
d) combination wrench

TYPEWRITER

92. What escapements require synchronization?

    a) 10, 12 space
    b) 12, 16 space
    c) 16, 10, 12 space
    d) 6, 8, 14, 16 space

93. The machine is in six o'clock position when:

    a) the backspace keylever is held down
    b) the fixed dog is holding escapement
    c) the loose dog is straight up and down with a tooth of escapement wheel
    d) during tabulation

94. The purpose of the Fold-A-Matic is to:

    a) feed paper into carriage
    b) control line lock
    c) disengage ribbon drive
    d) inspect and clean internal parts

95. Line lock operates during

    a) typing or tabulating into the right margin
    b) typing into left margin
    c) carriage returning into left margin
    d) backspacing into right margin

96. When the carriage is in the right margin, one of the following can be operated:

    a) space key
    b) type bar
    c) backspace key
    d) none of the above

97. The purpose of the margin release mechanism is to allow:

    a) the operator to bypass the right margin only
    b) the operator to bypass the right and left margins
    c) the operator to bypass the left margin only
    d) the operator to restore jammed type bars

Appendix A, continued

98. When the space key is held down, carriage movement is prevented by:

   a) loose dog
   b) fixed dog
   c) line lock
   d) backspace pawl

99. The purpose of the ribbon drive clutch assemblies is to:

   a) release ribbon drive during tabulation
   b) release ribbon drive during use of carriage release levers
   c) allow ribbon drive clutch shaft to rotate counterclockwise only
   d) allow ribbon drive clutch shaft to rotate clockwise only

100. During tabulation the ribbon drive shaft

   a) is disengaged
   b) rotates counterclockwise
   c) rotates clockwise
   d) drives left ribbon spool

101. The ribbon will not raise when

   a) selector is in red position
   b) selector is in center position
   c) selector is in black position
   d) selector is in stencil position

102. When would both ribbon reverse plungers be down?

   a) when both ribbon spools are empty
   b) when both ribbon spools are half full
   c) when right spool is empty
   d) when left spool is empty

103. When the touch control regulator lever is down

   a) the ribbon will not raise
   b) the keyboard will be linelocked
   c) the keyboard will have the heaviest touch
   d) the keyboard will have the lightest touch

104. The tabulator blade will stop movement of the carriage when contacting:

   a) a set tabulator stop
   b) the loose dog
   c) the fixed dog
   d) the tabulator brake

105. The tabulator brake does not operate:

a) during long tabulator operations
b) during typing
c) during any tabulation operations
d) during short tabulation operations

106. Tabulator stops on elite space machines can be set:

a) at odd carriage scale positions
b) at any carriage scale position
c) at even carriage scale positions
d) with tabulator clear key

107. When the tabulator key is fully depressed

a) tabulator brake will not operate
b) carriage will not move
c) loose dog will be holding the carriage
d) ribbon will not drive

108. The ribbon drive and reverse shaft rotates

a) clockwise during carriage return
b) counterclockwise during carriage return
c) counterclockwise at all times
d) clockwise at all times

109. When the ribbon reverse toggle is locked to the front:

a) ribbon will not drive
b) left ribbon spool will wind ribbon
c) right ribbon spool will wind ribbon
d) ribbon is disengaged

110. The line lock adjusting plate prevents an occasional escapement lock up:

a) if an escapement trip occurs before contacting the right margin stop
b) when the loose dog releases the escapement wheel at left margin
c) when escapement is normal
d) in fine pitch machines, if a trip should occur when machine is line locked

111. What supplies tension to move the carriage to the left?

a) operator, during carriage return
b) main spring
c) tabulator friction brake
d) backspace pawl

APPENDIX B

Student ______________________

Teacher ______________________

School ______________________

STUDENT STRENGTHS AND ABILITIES*

	Superior	Average	Below Average
Construction Cluster			
Carpentry			
Plumbing			
Masonry			
Electricity			
Painting			
Metal Forming and Fabrication Cluster			
Machining			
Sheetmetal			
Welding			
Fabrication			
Electro-Mechanical Installation and Repair Cluster			
Air conditioning and refrigeration service			
Business machine service			
Home appliance service			
Radio and television service			

STUDENT INTERESTS**

	+	Student Score
Carpenter		
Painter		
Plumber		
Electrician		
Radio-TV Repair		
Sheetmetal worker		
Machinist		

*This is a summary of an evaluation sheet listing the student's achievement in each of the approximately one hundred tasks in the cluster. A detailed listing of every task, and the student's competency in each is available upon request.

**As reflected by results of the Minnesota Vocational Interest Inventory.

+If student's score is higher than this value his interests are similar to those people working in this occupation.

APPENDIX C

CONSTRUCTION CLUSTER

	Tools
1 set	Pipe dies 1/8"-2"
1	Pipe cutter
4	24" steel rules
4	Hand seamers with depth gauge, adjustable, 1/4"-1"
4	Soldering coppers, 2 lb.
3	Assorted yarning irons
2	Picks, railroad
2	Garden rakes
2	Heavy duty thermometers
4	Bricklayers jointers, assorted
1	Stiff broom, 18" push
2	Concrete edgers
2	Joint rakers
1	Serrated trowel
13	Trowels-2 floats, 1 darb 2 straight steel, 6 brick, 1 drywall corner, 1 drywall joint
2	Keyhole saws
1	Drywall 6" elastic knife
1	Drywall carrier-lifter
2	Stapling hammers
2	Hatchets
1	Set of wood chisels
4	Putty knives, elastic blade
6	Hand scrapers, 3 x 2
1 doz.	6' folding rule, wood
1 doz.	8' steel tapes
4	24" aluminum levels
4	48" mason's levels
6	24" steel framing squares
4	Shovels, 2 long handled round point, 2 square point

	Equipment
1	Trap snake, 5 1/2'
1	Gas welding outfit and accessories
1	Portable jig saw
3	Roof brackets
1	Rubber tired wheelbarrow
4	50' heavy duty extension cords
3	Electric drills, 1/4", 3/8", 1/2"
1	8" portable electric saw
1	3" x 24" dustless belt sander
1	10" radial arm saw
1	Sewer rod, 50' x 1/2"
1	LP gas soldering kit
1	Putty softener
1	14" drill press
2	50' garden hose, 1/2"
1	Heavy duty orbital sander
1	Industrial vacuum cleaner
3	6' step ladders
1	20' extension ladder
3	Paint roller pans
1	Oil-less diaphragm type compressor, adjustable spray gun, 1 qt. cap
1	Bench grinder
1	Cement mixer, 1/4 or 1/3 bag
1	Mortar box
2	10 qt. pails
1	Salamander
4	Bench vises, 3 1/2" jaw
1	Machine pipe cutter, reamer threader

	Materials
400	Red common brick
10	Fire brick
100 ft.	Nylon chalk line
4	Pieces of chalk
10	4" octagonal boxes
10	4" octagonal box covers
4	20 oz. cans soldering paste
5 lb.	Rosin core solder
4	Rolls electrician tape
	1/8" x 3' threaded pipe
50 ft.	Thin wall conduit
1	Ground clamp
20 ft.	Black iron pipe
10	Romex switch boxes, 2" deep
10	BX and conduit switch boxes, 2" deep
10	BX box connectors
6	Romex box connectors
10	Conduit box connectors
10	Conduit couplings
6	1/2" thin wall conduit elbow connectors
1	Assortment of small, medium and large wire nuts
8	Pull type porcelain receptacles with 3 wire outlet
10	Duplex receptacles with 3 prong outlet
10	Single pole toggle switches
200 ft.	Romex cable, 14 gauge with ground wire
15 ft.	6 gauge cable

Tools

1	Mortar hoe
3	8 pt. hand cross cut saws
2	5 1/2 pt. hand rip saws
5	10" hack saw frames
2	Gooseneck wrecking bars, 24"
8	Hammers, 6-16 oz, 2-13 oz., 2 straight claw, 6 curved claw
4	Ball peen hammers, 12 oz.
8	Screwdrivers, assorted 1"-8"
1 set	Phillips head screw drivers
1	Allen wrench set
4	Adjustable wrenches, 4"-12" length
1 set	Combination box-open end wrench 3/8"-1 1/4"
4	Side cutting pliers, 8"
2	Combination pliers, 8"
1 set	Aviation snips
1 set	Combination snips, 10"
6	10 " files-2 bastard, 2 second cut, 2 smooth cut
6	Wire brushes
2 doz.	Flat utility varnish brushes- 1 doz. 2", 1 doz. 3"
1 doz.	Cold chisels, 2 ea.-1/4", 3/8", 1/2", 5/8", 3/4", 1"
5	Nail sets, 1/32-5/32
2	Rubber mallets, 2 1/2 x 6"
1	Axe
2	Sliding t-bevels
1	Sledge hammer, 6 lb.
4	Bricklayers hammers, 24 oz.
2	Nail pullers, 18"
2 sets	Wood bits, 1/4"-1" by 16ths 1-1 1/2" by 8ths
2	Ratchet braces

Equipment

1	Gas soldering oven
2	120 oz. oilers (pump)
1	Used hot water heater
1	Used water pump
1	Used toilet
1	Used lavatory
1	Used ceiling fan
1	Portable tripod pipe vise
1	Plumber's portable heating furnace
1	24" sheet metal brake
1	5 gal. "safety" gasoline can
1	Class A-B-C fire extinguisher

Materials

25'	2 gauge entrance cable
1	Electric stove receptacle
1	60 amp. entrance panel
1	Disconnect switch
1	Entrance head for #2 cable
1 ea.	Door bell and buzzer
100 ft.	Low voltage bell wire
2 boxes	Insulated staples
2 boxes	Electricians staples
2	Round brass push button bell switches
1	Door bell transformer
2 boxes	Plug fuses, 15 amp & 20 amp
20	Straps for 1/2" conduit
2 pkgs.	Fiber bushings for BX
300 ft.	12 ga. single conductor wire, 100' white, 100' black, 100' red
2	Toggle switches with pilot light
3 doz.	Hack saw blades, 16, 24, 32 TPI
2 gal.	Gasoline
1 gal.	Cutting oil
4 bags	"Sacrete"
4 bags	Portland cement
2 bags	Lime
1 ton	Washed sand
1 ton	Crushed stone
20 lbs.	Each- 6, 10 penny common nails
100 lbs.	Each- 8, 16 penny common nails
100 ft.	1/2" reinforcing rod
2	Bales straw
1	20' x 20' drop cloth
1	20' x 20' polyethylene cover

Tools

1	set	Auger bits
1		Expansive bit
1	set	HS twist drills, 1/16-1/2 by 64ths
1	set	Masonry bits, 1/4-3/4"
6		Bricklayers corner blocks
2		1/4" hand drills
1	set	Star drills, 1/4"-1"
2	doz.	Paint applicator rollers
5		Pipe wrenches, 8", 10", 12" (2),14"
2		Bench yoke vices, 1/8- 2 1/2
1		Smooth plane
2		Jack planes
1		Block plane
2		Cable rippers
1		100' fish tape
2		Electricians knives
1		Digging bar
1		Conduit bender
1		Wire gauge
1		Pipe reamer
1		Crow bar
1		Earth tamper
2		Chipping hammers & brush
1		Asbestos joint runner
2		9" levels
1		Copper tubing cutter
1		4" Soil pipe cutter
1		Pot for melting lead
1		Ladle for pouring lead
6		8" C-clamps

Equipment

Materials

300		8 x 8 x 16 concrete blocks
10		Safety helmets
10		Dust masks
25		Safety glasses
25	prs.	Gloves
200	ft.	14 ga . galvanized wire
100	sq. ft.	Reinforcing mesh
1	gal.	Clear waterproofing
5	gal.	Asphalt waterproofing
1	gal.	Clear cuprinol
2	doz.	Carpenter's pencils
300		Sheet flint paper, fine, medium
3	qts.	Paste wood filler
2	cans	Plastic wood, walnut, mahogany
1	doz.	Rolls masking tape, 1/2"
2	gal.	Paint and varnish remover
2	gal.	Deft wood finish
1	gal.	Wood sealer
1	gal.	White shellac
1	gal.	Varnish
4	gal.	Assorted paints in quarts, interior and exterior enamels, flat and gloss, etc., latex, oil base, etc.
1	gal.	Primer
4	gal.	Paint thinner
1	qt.	Etching solution
4	lbs.	Glazing compound
10	lbs.	Finishing nails, 4, 6, 8 penny
10		Metal hangers for supporting 2 x 8 floor joists

Tools	Equipment	Materials	
		1 box	Staples for stapling hammers.
			Assorted sizes and types of fasteners for connecting wood to masonry (toggles, shields, etc.)
		20 lb.	Bag joint system
		50 ft.	1/2" rigid copper tubing Copper fittings for 1/2", 4 ea. elbows, tees; 2 ea. 45 elbow, coupling, cap, adapter, stop valve
		10 ft.	4" soil pipe, cast iron fittings for 4" soil pipe, 1 hub end closet bend with 1 1/2 tap, 2 elbows, 2 tee with 2" tap
		100 ft.	1/2" galvanized pipe; galvanized fittings, 4 ea. elbows and tees, 2 ea. coupling, union, street elbow, plug cap, 45 elbow
		1 can	Pipe joint compound
		10 ft.	Clay drainage tile
		2	Mounting brackets for lavatory
		30 ft.	Semi-rigid plastic pipe, ABS, 1"
		2 ea.	Plastic fitting, adapter, coupling, tee, elbow, bushing (1"), 1 can cement
		1	Toilet seat
		20 ft.	Flexible plastic pipe, 1"
		2 ea.	Plastic fittings, adapter, coupling, tee, elbow, clamps (1")
		15 ft.	Foam plastic pipe covering for 1/2" pipe
		4 pkgs.	Wrap around pipe insulation

Tools	Equipment	Materials	
		2	Sheets 3' x 8' galvanized iron, 28 ga.
		20 ft.	3/4 x 3/4 angle iron
		1 box	Assortment of faucet washers
		6	2 x 6 x 12
		14	2 x 6 x 8
		14	2 x 6 x 10
		4	2 x 8 x 8
		12	2 x 8 x 10
		6	2 x 8 x 12
		25	2 x 4 x 14 or
		50	2 x 4 x 8
		18	2 x 4 x 12
		13	1/2 x 4 x 8 plywood
		350	(board ft.) 1 x 6 or 1 x 8 R & G or shiplap
		5	1/2 x 4 x 8 insulating sheathing
		2	2 x 12 x 16
		3	2 x 12 x 10
		2	2 x 10 x 10
		10	1 x 10 x 16 common
		10	1 x 8 x 10 common
		100	(board ft.) Porch flooring (fir)
		1	Adjustable jack post
		50	(sq. ft.) Roll roofing (approx.)
		50	(sq. ft.) Half lap roll roofing with slate surface & adhesives (approx.)
		5	10' length of galvanized roofing
		18 ft.	Ridge roll
		1 roll	Building paper
		500	(sq. ft.) Aluminum foil
		75	(sq. ft.) Blanket insulation
		14	3/8 x 4 x 8 sheetrock
		64	(sq. ft.) Rock lath

Appendix C, continued

Tools	Equipment	Materials	
		2	(bundle) 1 x 3 firring strip
		26 ft.	Drip edge
		16 ft.	Gutter with hangers
		8 ft.	Downspout & fittings
		3 tubes	Steel wool-coarse
		5 lbs.	Oakum
		20 lbs.	Pig lead
		1 gross	F.H. wood screws 1"-#8, 1 1/2"-#10 and R.H. wood screws 1"-#8
		5 lbs.	Asbestos cement
		2	Sal Ammoniac blocks
		5 lbs.	Assorted welding rod
		2 qts.	30w oil
		12	1/2 x 12 machine bolts
		6	#6 Sash brushes
		2	Asphalt roof coating brush
		1/2 pt.	Mahogany, maple, walnut oil stain
		2 qt.	Brush cleaner
		1 box	Glazier points
		3 gross	Assorted sheet metal screws (pan head)

METAL FORMING AND FABRICATION CLUSTER

Tools

12	12" Steel scales
6	24" Steel scales
12	Scribes
24	Hack saw (hand) blades
	Assorted files
	Abrasive cloth
1 doz.	Combination squares
2	Protractor heads
4	Centerhead
2	Hermaphrodite calipers
3	Surface gauges
6	Dividers
1	Trammel points
6	Prick punches
6	Center punches
1	Surface plate
3	Countersink center drills (3 sizes)
3	Outside calipers
6	0-1" Micrometer (outside)
2	1-2" Micrometer (outside)
1	2-3" Micrometer (outside)
1	3-4" Micrometer (outside)
1	4-5" Micrometer
1	5-6" Micrometer
1	6" Vernier caliper
1	12" Vernier caliper
	Reamers - taper shank
	Reamers - straight shank
2	Boring bars
2	Counterboring tools
2	Parting tools
1	Necking tools

Equipment

4	Lathes
4	3-jaw chucks
4	4-jaw chucks
2	Collet set (assortment)
2	Face plates & assorted Lathe Dogs
4	L.H. tool holders
4	R.H. tool holders
6 doz.	Tool bits
6	Dead centers
4	Floating centers
1	Power hack saw
1	Power band saw

Materials

16	Goggles, safety
6	Machine brushes
1 gal.	Cutting oil
1 gal.	Heavy oil (machine)
1 gal.	Kerosene (for alum.)
1 lb.	Can of grease
5 gal.	Varsol
4	(tubes) White lead

	Tools		Equipment	Material
1 set	Fraction drills, 1/8-1"	1	Shaper	
1 set	Number drills, to 3/4", 1-60		Clamps	
1 set	Letter drills, to 3/4", A-Z		Hold-downs	
1	Letter drill gauge		Vises	
1	Number drill gauge		Tool holders	
1	Fraction drill gauge		Cutting tools	
1 1/4"	Reamers			
1 1/2"	Reamers			
1 5/8"	Reamers			
1 3/4"	Reamers			
3	Dial gauge (1/10000" graduation)			
3	Lubricant cans or dispensers			
3	V-blocks	1	Drill press	
1	Angle plate			
1	Depth micrometer (1/10000")			
1	Plug gauge			
1	Telescope gauge set			
1	Spot facing tools			
2	Countersinks			
	Counterboring tools			
6	Center gauges	1	Grinder (bench)	
			Drill bit attachment	
			Assorted grinding wheels	
		1	Pedestal grinder	

	Tools		Equipment		Materials
1	Wheel dresser	1	Surface grinder Assorted wheels		
1	Vise				
1	Clamp				
1	Magnetic chuck				
	Parallel bars				
	Assorted shims				
2	Assorted step blocks				
1	Sine bar 8"				
6	Plastic face hammers				
1	Milling cutters	1	Horizontal milling machine		
	Vernier height gauge				
	Inserted tooth cutters				
	Stagger tooth cutters				
	Spacing & bearing collars for milling machine				
	Arbors & collets for millers				
	Slitting saw 1/16" x 4"				
	Assorted cutters for vertical milling machine				
	Slab	1	Vertical milling machine	1	Fraction to decimal chart
	Helical tooth				Cloths or waste materials
	Form relieved				
	Inserted tooth				
	Stagger tooth				
	Side				
	Spacing & bearing collars for vertical milling machine				

	Tools		Equipment		Materials
1	10' metal tape	1	Squaring shears	8 pr.	gloves, welding
2	Sheet metal gauge	1	Saber saw (metal use)	2 pr.	gloves (handling sheet metal)
3	Hand shears (straight)	1	Power squaring shears		Metal adhesive compound
3	Aviation snips (R.H.)	1	Ring & circle shears		Solder
3	Aviation snips (L.H.)	1	Bench lever shears		Flux
3	Combination snips	1	Hand notcher & assorted blades		Tinning solution
1	Bulldog snips	1	Nibbler		Sheet metal screws
1	Double cutting snips	1	Portable power shears		Bolts & nuts
2	Circle snips	1	Slip roll forming machine		Washers (tightening tools)
2	Hawk's bill snips	1	Crimping machine		Rivets
2	Hand riveting tools	1	Beading machine		Allen set screws
3	Straight snips	1	Brake		
2	Compound shears	1	Bar folder		
		1	Pittsburgh lock seam former		
		1	Drive cap machine		
		1	Spot welder		
		4	Soldering coppers		
		1	Power riveting tool		
			Dividing head & accessories for Miller		
		1	Sheet metal punch, hand operated		
2 sets	Fillet gauges		Gas cutting torch & accessories	1/4"	Heavy plate
4	Try-squares 8"		Ground wire & clamp		Filler rods
4	Steel square 24"		Electrode wire & clamp		Electrodes
8	Chipping hammers		AC/DC Welding machine		Brazing rods
8	Wire brushes		Shielded welding booths		Ferrous metal for welding exercises
8	Face shield, welding		Regulators		Ferrous pipe stock
8	Welding aprons		Assorted welding tips		
6	Spark lighters		Gas cutting head		
4	Welding tank wrenches		(MIG welding equipment)		
			Consumable wire		
			Belt sander & abrasive belts		

	Tools		Machines	Materials
2	Scales balance	1	Power riveting tool	Adhesives
	Measuring valve (adhesives)	1	Electric impact wrench	Chemical cleaner
	Adhesive mixing vessels			Abrasive cleaner
	Assorted clamps & jigs			Spray gun cleaners
	Adhesive spray equipment			
	Assorted Allen wrenches			
2 ea.	Phillips-head screwdrivers (2 sizes)			
3 ea.	Standard screwdrivers (3 sizes)			
2	Offset screwdrivers			
	Adjustable wrenches			
	Torque wrench			
	Socket wrench (T-handle)			
	Socket wrench (offset)			
	Socket wrench ratchet			
1 set	Open-end wrench			
1 set	Box-end wrench			
3	Drift punch			
6	Hammers (assorted shapes)			
3 sets	Cold chisels (11 sizes)			
2	Aligning punches			
1	Pipe vise			
	Assorted C-Clamps			
3	Machinist's vise			
3	Swivel vises			
1	Pipe cutter			
2	Diagonal cutting pliers	1	Hand power drills	
1	Bolt cutters			
2	Side cutting pliers			
1	Tube cutter			
4	Combination pliers			
	Assorted dies, NF, NC (1/4-3/4"), NF, NC (#6-#12)			
	Assorted wrenches for dies			
	Gasket punch			
2	Sliding T-bevel square			
2	Wire gauge			
	Assorted taps, NF, NC (1/4"-3/4"), NF, NC (#6-#12)			

Tools

1	Thread gauges
1	Inside micrometer
1 set	Gauge blocks
2 sets	Inside calipers
1	Hook rule
1	Thread micrometer
1 set	Feeler gauge
2	Ball peen hammers
2	Straight peen hammers
2	Cross peen hammers
2	Wooden mallets
1	Flaring tool
	File cards
	Oil stones
	Tongs - long handled

Machines

2	Hand power drills (1/4", 1/2")
	Anvil
	Arbor press

Materials

	Machinist's blue
	Copper sheets, 14-26 gauge selected sizes
	Steel, hexagon & square
	Cold roll, 1/4-3/4 in 12' lengths, selected sizes
	Round-cold rolled, dia. 1/8 to 1 1/4 selected sizes
	Sheet - #18, 20, 22, 24, 26, C.R. U.S. Gauge selected sizes
	Sheet, galvanized, No. 18, 20 24, 26, 28 selected sizes
	Aluminum sheet, 12-20 gauge
10'	1" & 1 1/2" cold roll
10'	3/4" & 2" cold roll
1	1" D. Aluminum rod
1	1/2" D. Aluminum rod

ELECTRO-MECHANICAL INSTALLATION & REPAIR CLUSTER

	Tools
5	Screwdriver sets (standard tip-assorted sizes 1 1/2"-8")
3	Screwdriver sets (Phillips head-assorted sizes 3"-8")
1	Screwdriver ratchet
1	Screwdriver offset
5	Hex nut driver set
3	Combination flare nut wrench set (3/8"-3/4")
5	Wrench sets - open end (1/4"-1")
5	Wrench sets - box end (5/16"-1 1/8")
1 ea.	Socket wrench set (1/4"-3/8"-1/2")
6	Adjustable wrenches 6"-8"-12" (2 ea.)
2	Spanner wrenches
1	Allen wrench set
1	Special valve ratchet wrench (ref. work)
5	Pliers combination
3	Pliers - slip joint
6	Pliers - needle nose
2	Pliers -water pump
2	Pliers - round nose
5	Pliers - diagonal (3"-6")
3	Vice grips pliers
3	Electricians pliers
2	Pliers-gas & burner
6	Pliers - wire strippers
1	Hand riveter
1	Torque limiting wrench (inch lbs.)
1	Torque limiting wrench (foot lbs.)
1	Pipe wrench - 10"
1	Set files (needle)
3	Files - 8"-12"-single cut
2	Files - round-8"
2	Files - rat tail - 6"

	Equipment
3	Volt-ohm milli-meter meters
5	Continuity testers
3	Amp-probes
1	Amp-meter
1	Low-range Ohm meter
1	Sling psychrometer
1	Anemometer
1	Manometer (mercury)
1	Vacuum-tube voltmeter
1	Tube tester
1	Signal generator
1	Oscilloscope
1	Capacitor tester
1	Capacitor decade
1	Resistance decade
1	Audio generator
1	Simpson thermo-meter with extra thermocouple leads
4	Test cord sets
1	Gas welding outfit & access.
3 prs.	Asbestos gloves
1	Heat jet soldering fit
3	Welding goggles
1	Halide leak detector
6	36" flexible charging hoses
1	Charging system
1	Wet wick vacuum indicator
1	Vacuum pump
1	Electronic leak detector
2 set	Gauge manifolds with vacuum and pressure gauges

	Materials
2 doz.	Hacksaw blades (wave set 32 teeth per inch)
2 doz.	Hacksaw blades (24 teeth per inch)
6 gal.	Refrigeration oil (1 gal. of ea of the 6 standard viscosities)
	Litmus paper
	Sulphur stick
10 oz.	Coil Silver solder
1 lb.	Soft solder 40/60 (solid wire)
10 oz.	Silver solder flux)
1 lb.	Solder (rosin core)
1 box	Spaghetti & sleeving assortment
1	Test lead interchange kit
1	Capacitor assortment
1	Resistor assortment
1	Solderless terminal kit
100'	TV lead wire 300 ohm
100'	Parallel (lamp) cord
100'	Power cord
12 roll	electrical tape
2 doz.	Jiffy push-pull plugs
2 doz.	Flexible rubber handle cap
1 set	Assorted tips for soldering irons
6	Small paint brushes 1/4"
25	Emery cloth, fine
1 lb.	Light weight grease
1 qt.	Machine oil

Appendix C, continued

	Tools
2	File card & brush
2	Aviation snips
2	Cold chisel sets (1/4"-5/8")
2	Punch & chisel sets (center & pin punch)
3	Hammer - ball pein (2 large & 1 small)
1	Hammer - claw
2	Hammer - soft face
3	Hacksaws 10"
2	Levels
4	Steel rules (8')
1	Compass saw
1	Pyrometer
1	Thickness guage (.0015"-.025")
1	3" jaw puller
1	Set TV Alignment tools
1	Socket punch set
1	Jumper cable for TV
1 set	Rigid spring-type tube bender (set of 8-1/4"-7/8")
1	Soldering iron (small with interchangable tips)
1	Spring type tubing bender (set of 1 1/4-5/8)
3	Tubing cutter 1/8"-1" dia. with rollers and reamer
3	Flaring tools 3/16-5/8 o.d.
1	Sawing fixture for cutting tubing
5	Stem type refrigeration thermometer
1	Dial type thermometer with a remote sensitive bulb
3	Spiral flute burring reamers 1/8-1 1/4"
2	Swage set (set of 5 5/16-7/8" o.d.)
1	Pipe threader sets (1/4-1 1/2")
1	Pipe cutter

Equipment

	Materials
6	Penetrating oil (spray cans)
1 lb.	Nichrome resistance wire
Assort.	Bakelite wire (nuts) connectors
Assort.	Key & rivets
Assort.	Cotter & shear pins
Assort.	Retaining rings
Assort.	Bolts & nuts
Assort.	Cap screws
Assort.	Set screws
Assort.	Sheet metal & self tapping screws
Assort.	Washers-Flat & lock

	Tools	Equipment	Materials
1	Spiral ratchet pipe reamer 1/8 to 2" capacity		
3	Soldering guns		
1 set	External tubing brushes 3/8"-1		
3	Internal tubing brushes		
6	12" steel rules		
1	Fitting resurfacer		

TYPEWRITER REPAIR - all materials to be ordered from: Ames Supply Agency,
738 9th Street, N.W., Washington, D.C.

	Tools
5	#4 wiring pliers with duck bill jaws
5	#14 parallel flat nose pliers
5	#17 diagonal cutting pliers
5	#19 long needle nose pliers with side cutting jaws
5	#42 link bender
5	#104-7-C curved tweezers
5	#90 combination spring hook
5	#77 brass hammer
5	#350 flat, double-end spanner wrench set
5	#AVS-175 oiler
5	#81-6 screwdriver 6" blades, 3/16 bit
5	#46 Smitty Jr. Allen wrench set
5	#81-8 screwdriver 8" blade, 7/32 bit
5	#91 Spring hook set
5	#81-4 Yankee screwdriver (heavy)
5	4" blade, 3/16" bit
5	#83-4 screwdriver (light) 4" blade, 9/64 bit
5	#83-6 screwdriver 6" blade, 3/64 bit
5	#83-8 screwdriver 8" blade, 9/64 bit
3	#8-1 large cleaning brush
3	#8-16 scrubbing brush
12	Transparent plastic boxes (parts storage
3	Pen oiler #121
3	Atomizer
3	Adding machine grease gun
3	#74 needle file kit
5	#940 punch kit
3	#550 tattelite tester
1	#109 set of drills
3	#210 trip gauge
5	#104-7 tweezers
2	#86 offset screwdriver
1 ea.	#TR-4 hold-e-zee screwdriver
	#TR-6 hold-e-zee screwdriver
	#TR-8 hold-e-zee screwdriver

	Equipment
5	KM brake turntables no. 102
1	Steam cleaning system
1	Air compressor
1	Clean-o-matic tank lg. set tub with two lg galvanized tubs may be substituted)
1	Oven or heat lamp
1	Paint spray booth with exhaust system
5	Mechanic's lamp

	Materials
1/2 gal.	Typewriter oil
5 gal.	Varsol
1 gal.	Dentured alcohol
1 gal.	Ammonia (household)
2 qt.	Lix cleaner
2	Typewriter oil in spray cans (16 oz. cans
2	Droil (solvent for loosening frozen parts - 12 oz. can)
4 oz.	Dry graphite
2	Cleaner-lubricant spray can (6 oz. can)
1/2 lb.	Non-fluid oil (adding machine lub.)

APPENDIX D

APPENDIX D

UNIVERSITY OF MARYLAND
COLLEGE PARK 20742

DEPARTMENT OF INDUSTRIAL EDUCATION
COLLEGE OF EDUCATION

Over the past four years a research team from the Industrial Education Department at the University of Maryland has been working with a new idea in vocational education known as the Cluster Concept. During the past two years we have supervised pilot programs in ten public schools which have used the curriculum developed here for this program.

In June, the first graduates from this course of study will be entering the job market. They will have had two years of experience as juniors and seniors, two hours per day, in one of the clusters listed below. The objective of the instruction they have received has been to equip them with job entry skills in each of the occupations included in the cluster.

Construction Cluster	Metal Forming and Fabrication Cluster	Electro-Mechanical Installation and Repair Cluster
Carpentry	Machining	Air conditioning and refrigeration serviceman
Masonry	Sheet Metal	Business machine serviceman
Plumbing	Assembly	Home appliance serviceman
Electricity	Welding	Radio and television serviceman
Painting		

We would like to know if you would be interested in considering any of these young men for employment following their graduation. If so, please return the enclosed form indicating where the major emphases of your business lay.

Sincerely yours,

Appendix D, continued

Yes, I am interested in considering graduates of the experimental Cluster Concept program for employment. The major emphases of my business are listed below.

SAMPLE

Construction Cluster

____ Carpentry

____ Masonry

____ Plumbing

____ Electricity

____ Painting

Metal Forming and Fabrication Cluster

____ Machining

80% Sheet Metal

15% Assembly

5% Welding

Electro-Mechanical Installation and Repair Cluster

____ Air conditioning and refrigeration service

____ Business machine service

____ Home appliance service

____ Radio and television service

Construction Cluster

____ Carpentry

____ Masonry

____ Plumbing

____ Electricity

____ Painting

Metal Forming and Fabrication Cluster

____ Machining

____ Sheet Metal

____ Assembly

____ Welding

Electro-Mechanical Installation and Repair Cluster

____ Air conditioning and refrigeration service

____ Business machine service

____ Home appliance service

____ Radio and television service

Any additional comments:

Company: ____________________

Address: ____________________

Signed: ____________________

Position: ____________________

Phone: ____________________

APPENDIX E

APPENDIX E

The following employers have expressed an interest in hiring graduates from the Cluster Concept Program:

CONSTRUCTION CLUSTER

Employer & Location

L. J. Brosuis, V. Pres.
Brosuis Home Corp.
431 Carrollton Drive
Frederick, Md.
662-2106

Carl L. Culler, Pres.
Floyd L. Culler, Inc.
49 South Carroll Street
Frederick, Md.
663-8562

Carson Johnson, Pres.
Johnson Contracting Co.
Hancock, Md. 21750
678-6375

James E. Grigg, Sec.
Kettler Brothers, Inc.
4701 42nd Street, N.W.
Washington, D.C. 20016
202-244-5400

Mr. Bushwell
Kopper Co., Inc.
Bush & Hamburg Streets
Baltimore, Md.
SA 7-2500

John J. Campbell, Pres.
Poolesville Development Corp.
P.O. Box 192
Poolesville, Md.
948-9411

Fred W. Rudy, Pres.
F. W. Rudy, Builder
101 Broad Street
Middletown, Md.
371-6006

Charles C. Stover, Pres.
Stover Bros., Inc.
120 W. Main Street
Thurmont, Md.
271-7258

Thomas D. Woodfield, Pres.
Thomas D. Woodfiedl & Son
25000 Ridge Road
Damascus, Md.
CL 3-2184

Mr. Paul Blank
Cee Bee Contractors, Inc.
5606 Marlboro Pike
Hillside, Md.

Appendix E, continued

METAL FORMING AND FABRICATION CLUSTER

Employer & Location

Richard P. McBourne
Acme Iron Works, Inc.
4900 Frolich Lane
Hyattsville, Md.
322-3900

Alfred E. Hornung, Pres.
American Iron Works, Inc.
P.O. Box 10
Bladensburg, Md.
277-8444

Rodger Kralsaw
Employment Supervisor
Black & Decker Mfg. Co.
Hampstead, Md. 21074

Edward B. Harrison
Plant Manager
Clark Machine Corp.
8330 Pulaski Hgwy.
Rosedale, Md.
687-3020

Claude Merkle, Pres.
Danzer Metal Works
2000 York Road
Hagerstown, Md.

John Balduson
Personnel Supervisor
David & Hamphill, Inc.
2000 Furnace Avenue
Elkridge, Md. 21227
796-2290

George T. Hill, Jr.
Eastern Products Corp.
1601 Wicomico Street
Baltimore, Md. 21230
727-8800 Ext. 221

H. Glenn Stone, Pres.
Frederick Tool & Die Co.
519 E. Church Street
Frederick, Md. 21701
662-5135

Samuel Spiegel, Tres.
Hamilton & Spiegal
2401 51st Place
Tuxedo, Md.
322-3150

Charles E. Bush, V. Pres.
Ingleside Plumbing & Heating
1101 Ingleside Avenue
Baltimore, Md. 21207

Mr. Bundy
Koppers Company
Bush & Hamburg Sts.
Baltimore, Md.

Charles Hagerich
Koppers Co., Inc.
Harmans Road
Harmans, Md.
SA 7-2500

George T. Shafer, Pres.
Machine Craft, Inc.
8104 Edgewater Avenue
Baltimore, Md. 21237

Robert W. Tracey, V. Pres.
Metalcraft Products, Inc.
Baltimore, Md. 21227
(1807 East Street)
247-1152

Sam Valdes, Pres.
Moualco, Inc.
4612 St. Barnabus Road
Marlow Heights, Md. 20031
423-5050

Charles P. Seller, Office Mgr.
Metal Products, Inc.
6520 Columbia Pk. Road
Cheverly, Md.
772-7200

Northwest Sheet Metal, Inc.
500 Nicholson Court
White Flint Industrial Park
Kensington, Md.

Harold Trovinger, Director
Shop Personnel
Pangborn Corp.
Hagerstown, Md.

D. R. Buschim, Mgr.
Pittsburgh DesMoines Steel Co.
750 Pittman Road
Baltimore, Md.
789-8000

John C. Mony, General Mgr.
Potomac Iron Works, Inc.
4711 Rhode Island Avenue
Hyattsville, Md.
779-7500

D. E. Stone, Jr.
Todd Steel Division of
Standard International
P.O. Box 950
Frederick, Md. 21701

Alban Tractor Co., Inc.
P.O. Box 9595
Baltimore, Md. 21237
(Charles P. Witmer, Manager)
686-7777

Appendix E, continued

ELECTRO-MECHANICAL INSTALLATION AND REPAIR CLUSTER

Employer & Location

B. L. Parker
M. A. Addante
3535 V Street, N.E.
Washington, D.C. 20018
526-2620 Ext. 277 or 283
General Electric Company
Major Appliance & Hotpoint Div.

John D. Craig, Sales Engineer
Baltimore Aircoil Co., Inc.
P.O. Box 7322
Baltimore, Md. 21227
799-1300 Ext. 37

Charles E. Bush, V. Pres.
Ingleside Plumbing & Heating Co.
1101 Ingleside Avenue
Baltimore, Md. 21207
747-2500

Sam Valdes, Pres.
Moualco, Inc.
4612 St. Barnabus Rd.
Marlow Heights, Md. 20031
423-5050

Matthew H. Gray
Sear, Roebuck and Co.
2800 V Street, N.E.
Washington, D.C. 20018
529-5500 Ext. 352

Donald Schmitz, Service Mgr.
Friden, Inc.
1724 Wisconsin Avenue, N.W.
Washington, D.C. 20007
FE 8-5700

Mr. William G. Huelin
District Service Mgr.
Westinghouse Appliance Sales
Washington Blvd. & Gorman Road
Laurel, Maryland

APPENDIX F

APPENDIX F

Carpentry

_____ 1. Mixing mortar for mudsills of a house.

_____ 2. Constructing a saw horse and trestle for use on construction site.

_____ 3. Cutting building material to length for a house.

_____ 4. Framing a box sill for a house.

_____ 5. Installing hangers and anchors for floor joists for a house.

_____ 6. Erecting floor and ceiling framing joists for a house.

_____ 7. Installing cross bridging between floor joists for a house.

_____ 8. Installing solid bridging between floor joists for a house.

_____ 9. Laying subfloors on floor joists for a house.

_____ 10. Building up corner posts for corner of framing in a house.

_____ 11. Laying out stud spacing for walls and partition.

_____ 12. Assembling walls and partitions for a frame house.

_____ 13. Erecting wall sections for a house.

_____ 14. Applying lap, plywood, or composition sheathing for a house.

_____ 15. Installing fire stops along plate in a house.

_____ 16. Installing staging brackets for house construction.

_____ 17. Installing single and double post scaffolding for house construction.

_____ 18. Framing a flat roof for a house.

_____ 19. Installing gable studs for a house.

_____ 20. Laying roof decking for a house.

_____ 21. Applying building paper to sidewall, rough floor or roof deck on a house.

Appendix F, continued

_____ 22. Building a foot rest for shingling a roof on a house.

_____ 23. Installing metal drip edge on roof for a house.

_____ 24. Applying roll roofing for a house.

_____ 25. Applying sheet metal roofing to a house.

_____ 26. Applying composition shingles to the roof of a house.

_____ 27. Installing a hanging gutter to a house roof.

_____ 28. Fastening wood to masonry with fasterners in a house.

_____ 29. Installing blanket, bulk, batt, rigid and metallic insulation in a house.

_____ 30. Installing backing to an interior wall of a house.

_____ 31. Applying commercial wall board to the interior of a house including the following types: insulating, dry wall (regular plus ray-board and thermo-lux).

_____ 32. Installing furring and grounds to interior of a house.

_____ 33. Applying lath to house studding.

_____ 34. Applying corner boards on a house.

_____ 35. Assembling basement stairs for a house.

_____ 36. Erecting roof and deck framing for a house porch.

_____ 37. Laying porch floors for a house.

Plumbing

_____ 1. Digging a trench for plumbing installation in a house.

_____ 2. Backfilling a trench following installation of plumbing lines for a house.

_____ 3. Preparing copper tubing for installation in a plumbing system for a house.

_____ 4. Preparing pipe for installation in a plumbing or gas supply system in a house.

_____ 5. Preparing cast iron soil pipe to pour a lead joint for a waste line in a house.

_____ 6. Preparing lead for pouring soil pipe joints for a house.

_____ 7. Laying a drainage field with clay pipe for a house.

_____ 8. Attaching mounting brackets for plumbing fixtures to frame construction.

_____ 9. Attaching mounting brackets for plumbing fixtures to masonry construction.

_____ 10. Installing a water closet seat in a house.

_____ 11. Insulating heating and water lines in a house.

_____ 12. Assembling a furnace for a house.

_____ 13. Installing duct work for warm air heating system in a house.

_____ 14. Installing plastic pipe for plumbing lines for a house.

_____ 15. Soldering sheet metal and copper tubing to be used in a house.

_____ 16. Repairing leaks in faucets in a house.

_____ 17. Repairing leaks in a water closet in a house.

_____ 18. Cleaning waste lines with a snake in a house.

_____ 19. Welding angle iron for pipe hangers.

Masonry

_____ 1. Setting up a work area in order to expedite the mixing of concrete on the job.

_____ 2. Cleaning and oiling concrete forms prior to and after use on a building.

_____ 3. Preparing a batch of cement, plaster, lime mortar and cement-lime mortar by hand and by machine at the construction site.

_____ 4. Installing rods and spreaders to space form section before pouring cement.

_____ 5. Wiring and bolting forms to prevent spreading during pouring.

_____ 6. Bracing sidewalls of forms to prevent spreading during pouring.

_____ 7. Installing anchor bolts in masonry walls and concrete to provide a place for securing future construction.

_____ 8. Protecting a concrete slab following finishing operations to provide for proper curing.

_____ 9. Erecting scaffolding for use by a mason at the building site.

_____ 10. Cleaning out mortar joints for tuck pointing on a masonry wall.

_____ 11. Pointing up a section of a brick wall to provide a finished appearance on a house.

_____ 12. Applying colorless coating to waterproof masonry surfaces above grade on a building.

_____ 13. Applying asphalt coating to waterproof foundation wall below grade on a building.

_____ 14. Pouring a section of footing containing reinforcing rods for a house.

_____ 15. Pouring a small reinforced concrete slab suitable for a porch deck on a house.

_____ 16. Installing footer forms to receive concrete for a foundation.

_____ 17. Setting a section of sidewalk form to receive concrete at a building site.

_____ 18. Finishing a samll concrete slab to provide utility and pleasing appearance.

_____ 19. Laying cement block for a wall in stretcher courses for a building.

_____ 20. Laying up a corner with cement block.

_____ 21. Laying up the following bonds to a height of 8 courses with mortar to illustrate a basic knowledge of each (running, common, Flemish, English, basket weave).

Electricity

_____ 1. Installing boxes for receptacles, switches, junctions and fixtures in a house.

_____ 2. Installing wiring from box to box in a house.

_____ 3. Connecting receptacles, single throw switches, fixtures and pilot lights to complete circuits in a house.

_____ 4. Erecting a temporary service pole for portable electric equipment used in building.

_____ 5. Installing an entrance head, wiring, fuse panel, receptacle, and ground on a temporary service pole.

_____ 6. Installing rigid, thin wall and flexible conduit in a house.

_____ 7. Installing a separate circuit for an electric range in a house.

_____ 8. Installing ground for a house wiring system.

_____ 9. Installing entrance cable on the exterior of a house.

_____ 10. Installing low voltage operated bells and signaling devices in a house.

_____ 11. Connecting a hot water heater to a power source in a house.

_____ 12. Connecting a water pump to a power source in a house.

_____ 13. Installing an attic fan or room cooler in a house.

Painting

_____ 1. Preparing a surface for application of stain on the interior or exterior of a house.

_____ 2. Preparing a surface for application of paint on the interior or exterior of a house.

_____ 3. Preparing a surface for application of a clear finish on the interior or exterior of a house.

_____ 4. Removing old finishes in preparation for resurfacing.

_____ 5 Preparing stain and applicator for use on the interior and exterior of a house.

_____ 6. Preparing paint and applicator for use in painting a house.

_____ 7. Preparing clear finishes and applicators for use on the exterior and interior of a house.

_____ 8. Cleaning and storing brushes, spray guns, and rollers following their use in applying finishing materials.

_____ 9. Glazing a window in preparation for painting.

_____ 10. Preparing joints and nail holes in dry wall construction to receive final finish.

_____ 11. Taping a dry wall joint.

_____ 12. Applying a corner bead to a dry wall installation.

_____ 13. Spackling nail holes and imperfections in walls and ceilings.

_____ 14. Finish sanding dry wall seams and patches in preparation for painting.

_____ 15. Applying finishing materials to provide protection and decoration of surfaces in or on a house with a brush, roller, or spray unit.

Sheet Metal

_____ 1. Tracing templates on sheet metal for cutting, bending and joining sheet metal items.

_____ 2. Cutting sheet metal with hand tools to produce a straight cut within 1/32 of an inch.

_____ 3. Cutting sheet metal with machinery to produce a straight cut within 1/32 of an inch.

_____ 4. Cutting sheet metal with hand tools to produce a circular cut within 1/32 of an inch.

_____ 5. Cutting sheet metal with machinery to produce a circular cut within 1/32 of an inch.

_____ 6. Cutting sheet metal with hand tools to produce an irregular cut within 1/32 of an inch.

_____ 7. Cutting sheet metal with machinery to produce an irregular cut within 1/32 of an inch.

_____ 8. Cutting sheet metal with hand tools to produce a notched cut within 1/32 of an inch.

_____ 9. Cutting sheet metal with machinery to produce a notched cut within 1/32 of an inch.

_____ 10. Cutting sheet metal to produce an interior cut within 1/32 of an inch.

_____ 11. Forming sheet metal cylinderical shapes on slip roll forming machine.

_____ 12. Forming sheet metal crimping on a crimping machine.

_____ 13. Forming sheet metal beading on a beading machine.

_____ 14. Forming single hem on bar folder or brake for strength.

_____ 15. Forming double hem on bar folder or brake for strength.

_____ 16. Forming single seam on a brake and/or bar folder for joining sheet metal parts.

_____ 17. Forming double seam on a brake and/or bar folder for joining sheet metal parts.

_____ 18. Forming Pittsburgh lock seam with machinery for joining sheet metal parts.

_____ 19. Forming cap strip seam on a drive cap machine for joining sheet metal parts.

_____ 20. Drilling sheet metal to produce a fastener receiver hole.

_____ 21. Adhering sheet metal parts with adhesives to produce an assembly.

_____ 22. Welding (spot) sheet metal parts to produce an assembly.

_____ 23. Joining sheet metal parts with seams.

Appendix F, continued

Machining

_____ 1. Turning stock on lathe to produce a faced surface.

_____ 2. Center drilling stock for mounting between centers.

_____ 3. Turning stock on lathe to produce a cylinderical shape to .001 of an inch.

_____ 4. Turning stock on lathe to produce a shoulder to .001 of an inch.

_____ 5. Turning stock on a lathe to produce a taper to .005 of an inch.

_____ 6. Drilling stock on lathe to produce a hole to .005 of an inch.

_____ 7. Reaming stock on lathe to produce a finished hole to .001 of an inch.

_____ 8. Boring stock on lathe to produce an enlarged hole to .001 of an inch.

_____ 9. Counterboring stock on lathe to produce a recessed hole to .005 of an inch.

_____ 10. Parting stock on lathe to produce a piece within 1/32 of an inch.

_____ 11. Necking stock on lathe to produce a necked shape to 1/32 of an inch.

_____ 12. Filing stock on lathe to produce a finished surface.

_____ 13. Machining stock on shaper to produce a flat surface.

_____ 14. Machining stock on shaper to produce two parallel surfaces to .005 of an inch.

_____ 15. Drilling stock on drill press to produce a hole to .005 of an inch.

_____ 16. Reaming a hole on drill press to produce a finished hole to .001 of an inch.

_____ 17. Spot facing a hole on drill press to produce a finished surface to .005 of an inch.

_____ 18. Countersinking on drill press to produce a fastener receiver hole.

_____ 19. Counterboring stock on drill press to produce an enlarged hole to .005 of an inch.

_____ 20. Grinding stock on bench grinder to remove excess metal.

_____ 21. Sharpening drill bits on a bench grinder.

_____ 22. Sharpening lathe cutter bits on a bench grinder.

_____ 23. Grinding lathe cutter bit blanks to specifications.

_____ 24. Grinding stock on surface grinder to produce a flat surface.

_____ 25. Grinding stock on surface grinder to produce two parallel surfaces to .001 of an inch.

_____ 26. Grinding stock on surface grinder to produce two perpendicular surfaces to .001 of an inch.

_____ 27. Grinding stock on surface grinder to produce an angular surface.

_____ 28. Machining stock on a horizontal milling machine to produce a flat surface.

_____ 29. Machining stock on a horizontal milling machine to produce parallel surfaces to .001 of an inch.

_____ 30. Machining stock on a horizontal milling machine to produce two perpendicular surfaces to .001 of an inch.

_____ 31. Machining stock on a horizontal milling machine to produce a shoulder to .001 of an inch.

_____ 32. Machining stock on a horizontal milling machine to produce an angular surface.

_____ 33. Machining stock on a vertical milling machine to produce a flat surface.

_____ 34. Machining stock on a vertical milling machine to produce two parallel surfaces to .001 of an inch.

_____ 35. Machining stock on vertical milling machine to produce two perpendicular surfaces to .001 of an inch.

_____ 36. Machining stock on vertical milling machine to produce a shoulder to .001 of an inch.

Appendix F, continued

Welding

_____ 1. Arc welding ferrous metals with A.C. welder to produce a flat butt joint.

_____ 2. Arc welding ferrous metals with A.C. welder to produce a flat lap joint.

_____ 3. Arc welding ferrous metals with A.C. welder to produce a flat inside corner joint.

_____ 4. Arc welding ferrous metals with A.C. welder to produce a horizontal inside corner joint.

_____ 5. Arc welding ferrous metals with A.C. welder to produce a horizontal tee joint.

_____ 6. Arc welding ferrous metals with A.C. welder to produce a vertical lap joint.

_____ 7. Arc welding pipe stock with D.C. welder to produce a butt joint while fixed.

_____ 8. Arc welding pipe stock with A.C. welder to produce butt joints while rolling.

_____ 9. Arc welding ferrous metals with D.C. welder to produce a flat butt joint.

_____ 10. Arc welding ferrous metals with D.C. welder to produce a flat lap joint.

_____ 11. Arc welding ferrous metals with D.C. welder to produce a flat outside corner joint.

_____ 12. Arc welding ferrous metals with D.C. welder to produce a horizontal inside corner joint.

_____ 13. Arc welding ferrous metals with D.C. welder to produce a horizontal tee joint.

_____ 14. Arc welding ferrous metals with D.C. welder to produce a vertical lap joint.

_____ 15. Arc welding pipe stock with D.C. welder to produce butt joints while fixed.

_____ 16. Arc welding pipe stock with D.C. welder to produce butt joints while rolling.

_____ 17. Pad welding low areas on metal sotck to renew stock to original height.

_____ 18. Gas welding ferrous metals stock to produce a flat butt joint.

_____ 19. Gas welding ferrous metals stock to produce a flat lap joint.

_____ 20. Gas welding ferrous metals stock to produce a horizontal outside corner joint.

_____ 21. Gas welding ferrous metals stock to produce a horizontal inside corner joint.

_____ 22. Gas welding ferrous metals stock to produce a horizontal tee joint.

_____ 23. Gas welding ferrous metals stock to produce a vertical lap joint.

_____ 24. Gas cutting ferrous metals.

_____ 25. Brazing ferrous metals to produce a flat butt joint.

_____ 26. Brazing ferrous metals to produce a flat lap joint.

_____ 27. Brazing ferrous metals to produce a horizontal outside corner joint.

_____ 28. Brazing ferrous metals to produce a horizontal inside corner joint.

_____ 29. Brazing ferrous metals to produce a horizontal tee joint.

_____ 30. Brazing ferrous metals to produce a vertical lap joint.

_____ 31. Brazing non-ferrous metals to produce a flat butt joint.

_____ 32. Brazing non-ferrous metals to produce a flat lap joint.

_____ 33. Brazing non-ferrous metals to produce a horizontal outside corner joint.

_____ 34. Brazing non-ferrous metals to produce a horizontal inside corner joint.

_____ 35. Brazing non-ferrous metals to produce a horizontal tee joint.

_____ 36. Brazing non-ferrous metals to produce a vertical lap joint.

_____ 37. Inert gas welding ferrous metals to produce a flat butt joint.

_____ 38. Inert gas welding ferrous metals to produce a flat lap joint.

Appendix F, continued

_____ 39. Inert gas welding ferrous metals to produce a horizontal outside corner joint.

_____ 40. Inert gas welding ferrous metals to produce a horizontal inside corner joint.

_____ 41. Inert gas welding ferrous metals to produce a horizontal tee joint.

_____ 42. Inert gas welding ferrous metals to produce a vertical lap joint.

_____ 43. Inert gas welding pipe stock to produce butt joints while rolling.

_____ 44. Inert gas welding pipe stock to produce butt joints while fixed.

_____ 45. Inert gas welding non-ferrous metals to produce a flat butt joint.

_____ 46. Inert gas welding non-ferrous metals to produce a flat lap joint.

_____ 47. Inert gas welding non-ferrous metals to produce a horizontal outside corner joint.

_____ 48. Inert gas welding non-ferrous metals to produce a horizontal inside corner joint.

_____ 49. Inert gas welding non-ferrous metals to produce a horizontal tee joint.

_____ 50. Inert gas welding non-ferrous metals to produce a vertical lap joint.

_____ 51. Inert gas welding non-ferrous pipe stock to produce butt joints while rolling.

_____ 52. Inert gas welding non-ferrous pipe stock to produce butt joints while fixed.

Assembly

_____ 1. Adhering parts with adhesives using hand processes to produce a metal bonded assembly.

_____ 2. Adhering parts with adhesives using spray equipment to a specified thickness to produce a metal bonded assembly.

_____ 3. Fastening metal parts with screws to produce an assembly.

_____ 4. Bolting metal parts with screws to produce an assembly.

_____ 5. Riveting metal parts to produce an assembly.

_____ 6. Tightening metal fasterners with hand power tools.

_____ 7. Mating parts together to produce sub-assemblies.

_____ 8. Mating parts and sub-assemblies together to produce major assemblies.

_____ 9. Holding parts in clamping devices for assembly of details, sub-assemblies and assemblies.

_____ 10. Cutting materials with hand tools to fit in an assembly.

_____ 11. Cutting materials with power tools to fit in an assembly to 1/32 of an inch.

_____ 12. Filing stock to produce a finished assembly to .001 of an inch.

_____ 13. Drilling holes in material with hand drill to produce a hole to .005 of an inch.

_____ 14. Drilling holes with a hand power drill to produce a hole to .005 of an inch.

_____ 15. Reaming stock with hand wrench to produce a finished hole to .001 of an inch.

_____ 16. Countersinking holes with hand tools to produce a fastener receiver hole.

_____ 17. Countersinking holes with power drill to produce a fastener receiver hole.

Appendix F, continued

_____ 18. Tapping holes with taps to produce a threaded hole.

_____ 19. Cutting threads with dies to produce a threaded member.

_____ 20. Punching materials with hand punches to produce a hole.

_____ 21. Punching materials with power tools to produce an assembly.

_____ 22. Checking dimensions of details with precision instruments for accurate assembly.

_____ 23. Checking dimensions of sub-assemblies and assemblies to produce accurate assemblies.

_____ 24. Measuring stock with precision instruments for assembly.

_____ 25. Stamping number and letters on metal stock for identification.

_____ 26. Hammering appropriate metal parts with various hammers.

_____ 27. Flaring metal tubing with a flaring tool to produce a flare.

_____ 28. Aligning parts in sub-assemblies and assemblies with hand tools.

Home Appliance Servicing

____ 1. Listing the symptoms to determine the defect(s) in small heating element appliances.

____ 2. Disassembling small heating element appliances for testing and repairing.

____ 3. Isolating the defect to a particular section of the heating element appliance with an Ohm meter.

____ 4. Isolating the defect to a particular component of the heating element appliance by testing.

____ 5. Replacing the defective part(s) of small heating element appliances.

____ 6. Testing the operations of the repaired small heating element appliance.

____ 7. Reassembling the repaired small heating element appliance.

____ 8. Retesting the assembled small heating element appliance.

____ 9. Listing the symptoms to determine the defect(s) in small motor driven appliances.

____ 10. Testing small electric motor appliances for continuity in cord and fields.

____ 11. Cleaning small electric motors with a brush, varsol and air.

____ 12. Disassembling small electric motor appliances for testing and repairing.

____ 13. Isolating the mechanical defects to a particular section of the small electric motor appliances.

____ 14. Isolating the electricl defect(s) to a particular section of the small electric motor appliances.

____ 15. Isolating the defect to a particular component of the small electric motor appliance with an Ohm meter.

____ 16. Replacing the defective part(s) of the small electric motor appliances.

____ 17. Testing the operation of the repaired small electric motor appliances.

Appendix F, continued

_____ 18. Reassembling the repaired small electric motor appliance.

_____ 19. Retesting the repaired small electric motor appliances.

_____ 20. Connecting the electricl supply to the electric range in the home.

_____ 21. Checking the installation of the electric range and making any final adjustments necessary.

_____ 22. Explaining the operation of the electric range to the customer.

_____ 23. Installing the vent system for the automatic dryer in the home.

_____ 24. Connecting the electrical supply to the automatic dryer in the home.

_____ 25. Testing the installation of the automatic dryer and making any final adjustments necessary.

_____ 26. Explaining the operation of the automatic dryer to the customer.

_____ 27. Connecting the water supply to the automatic washer in the home.

_____ 28. Connecting the electrical supply to the automatic washer in the home.

_____ 29. Checking the installation of the automatic washer and making any final adjustments necessary.

_____ 30. Explaining the operation of the automatic washer to the customer.

_____ 31. Connecting the electrical supply to the refrigerator in the home.

_____ 32. Checking the installation of the refrigerator and making any final adjustments necessary.

_____ 33. Explaining the operation of the refrigerator to the customer.

_____ 34. Observing the symptoms to determine the defect(s) in an automatic washer.

_____ 35. Disassembling the automatic washer in order to make the necessary repair(s).

_____ 36. Isolating the electrical defect(s) to a particular section of the automatic washer.

_____ 37. Isolating the mechanical defect(s) to a particular section of the automatic washer.

_____ 38. Isolating the defect(s) to a particular component in an automatic washer.

____ 39. Replacing the defective part(s) of the automatic washer.

____ 40. Repairing the defective part(s) of the automatic washer.

____ 41. Reassembling the repaired automatic washer.

____ 42. Testing the operation of the automatic washer.

____ 43. Making any final adjustments to the repaired automatic washer.

____ 44. Retesting the assembled automatic washer for water leaks and electrical shorts.

____ 45. Observing the smptoms to determine the defect(s) in an automatic electric dryer including service cord and fuse.

____ 46. Isolating the electrical defect(s) to a particular section of the automatic electric dryer.

____ 47. Isolating the mechanical defect(s) to a particular section of the automatic electric dryer.

____ 48. Disassembling the automatic electric dryer in order to make the necessary repair(s).

____ 49. Isolating the defect(s) to a particular component in an automatic electric dryer.

____ 50. Replacing the defective part(s) of the automatic electric dryer.

____ 51. Reassembling the repaired automatic electric dryer.

____ 52. Testing the operation of the automatic electric dryer.

____ 53. Making any final adjustments to the repaired automatic electric dryer.

____ 54. Retesting the assembled automatic electric dryer.

____ 55. Observing the symptoms to determine the defect(s) in a refrigerator.

____ 56. Disassembling the refrigerator in order to make the necessary repair(s).

____ 57. Isolating the electrical defect(s) to a particular section of the refrigerator.

____ 58. Isolating the mechanical defect(s) to a particular section of the refrigerator including testing for leaks.

____ 59. Isolating the defect(s) to a particular component in a refrigerator.

_____ 60. Replacing the defective part(s) of the refrigerator.

_____ 61. Repairing the defective part(s) of the refrigerator.

_____ 62. Reassembling the repaired refrigerator.

_____ 63. Testing the operation of the refrigerator.

_____ 64. Making any final adjustments to the repaired refrigerator.

_____ 65. Retesting the assembled refrigerator.

_____ 66. Observing the symptoms to determine the defect(s) in an electric range.

_____ 67. Isolating the electrical defect(s) to a particular section of the electric range.

_____ 68. Disassembling the electric range in order to make the necessary repair(s).

_____ 69. Isolating the mechanical defect(s) to a particular section of the electric range.

_____ 70. Isolating the defect(s) to a particular component in an electric range.

_____ 71. Replacing the defective part(s) of the electric range.

_____ 72. Repairing the defective part(s) of the electric range.

_____ 73. Reassembling the repaired electric range.

_____ 74. Testing the operation of the electric range.

_____ 75. Making any final adjustments to the repaired electric range.

_____ 76. Retesting the assembled electric range.

Business Machine Servicing

____ 1. Observing the symptoms to determine the defects in a typewriter.

____ 2. Disassembling the typewriter for cleaning.

____ 3. Cleaning the typewriter to remove dirt.

____ 4. Isolating the mechanical defects to a particular section of the typewriter.

____ 5. Isolating the electrical defect(s) to a particular component of the typewriter.

____ 6. Isolating the mechanical defect(s) to a particular component of the typewriter.

____ 7. Removing the defective part(s) of the typewriter.

____ 8. Replacing the defective part(s) of the typewriter.

____ 9. Reassembling the repaired typewriter.

____ 10. Testing the operation of the repaired typewriter.

____ 11. Removing the case, ribbon, and rubber parts to prepare the adding machine for cleaning.

____ 12. Cleaning the adding machine to remove dirt.

____ 13. Reassembling the cleaned adding machine.

____ 14. Testing the operation of the repaired adding machine.

Radio and Television Servicing

_____ 1. Observing the symptoms to determine the defective stage of the radio.

_____ 2. Reading a schematic to determine the values of components.

_____ 3. Checking the tubes in the suspected defective stage of the radio.

_____ 4. Removing the chassis from the cabinet for ease of servicing.

_____ 5. Isolating the defective components in a particular stage of the radio.

_____ 6. Replacing the defective components in a particular stage of the radio.

_____ 7. Replacing the chassis in the cabinet after a final inspection of the radio.

_____ 8. Making final operational checks and adjustment to the radio.

_____ 9. Observing the symptoms to determine the defective stage of the television set.

_____ 10. Checking the tubes in the suspected stage.

_____ 11. Removing the chassis from the cabinet for ease of servicing.

_____ 12. Isolating the defective components in a particular stage of the television set.

_____ 13. Replacing the defective components in a particular stage of the television set.

_____ 14. Replacing the chassis in the cabinet after a final inspection of the television set.

_____ 15. Making final operational checks and adjustment to the television set.

_____ 16. Installing an outdoor television antenna and transmission line.

Air Conditioning & Refrigeration Servicing

_____ 1. Removing the cover from the unit for ease of servicing.

_____ 2. Testing lines with detection device for leaks.

_____ 3. Replacing the defective components in the refrigeration unit.

_____ 4. Installing tubing between case and condensing unit.

_____ 5. Installing gages on condensing unit to charge the unit with refrigerant.

_____ 6. Evacuating the entire system with a vacuum pump to remove all non-condensibles.

_____ 7. Charging the system with the proper type and amount of refrigerant.

_____ 8. Retesting for leaks.

_____ 9. Making a wet-bulb test to determine correct cooling.

_____ 10. Replacing the cover on the unit to restore to the original condition.

APPENDIX G

APPENDIX G

CURRENT DISSEMINATED INFORMATION LIST BASED ON REQUESTS
(Excluding 1965-1966)

January, 1967

Department of Public Instruction	Dover, Del.
Wilmington Public Schools	Wilmington, Del.
California State Department of Education	Sacramento, Calif.
New York State School of Industrial & Labor Relations	Ithaca, N.Y.
Department of Education	Lansing, Mich.
Bradford County Area Vocational Technical School	Towanda, Pa.
Rutgers-State University	*New Brunswick, N.J.*
Centralia Public Schools	Centralia, Wash.

February

State Department of Education	Harford, Conn.
Montachusett Regional Vocational Technical School District	Fitchburg, Mass.
Pomona Unified School District	Pomona, Calif.
State of Florida Department of Education	Tallahassee, Fla.
Educational Research Council	Cleveland, Ohio
Vocational-Technical School	Easton, Pa.
Stanford University	Stanford, Calif.
Mankato State College	Mankato, Minn.
Association of Huntsville Area Contractors	Huntsville, Ala.

March

Washington State University	Pullman, Wash.
University of Arkansas	Fayette, Arkansas
Kansas City Board of Education	Kansas City, Mo.
Utah State University	Logan, Utah
Milwaukee Public Schools	Milwaukee, Wisc.

April

American Technical Society	Chicago, Ill.
North Carolina State University at Raleigh	Raleigh, N.C.
New York University	New York, N.Y.
Lynn A. Emerson	Portland, Ore.
University of Illinois	Urbana, Ill.

May

Western Michigan University	Kalamazoo, Mich.
South Park High School	Buffalo, N.Y.
Center for Vocational & Technical Education	Columbus, Ohio

June

Educational & Cultural Center	Liverpool, N.Y.
Kirschner Associates, Inc.	Albuquerque, N. Mex.

July

Community of Renewal Team of Greater Hartford	Hartford, Conn.
Department of Public Instruction	Des Moines, Iowa

August

Putnam County Board of Public Instruction	Palatka, Fla.
New Salem Academy Vocational High School	New Salem, Mass.
Ewing Miller Associates	Terre Haute, Ind.

September

City School District	Rochester, N.Y.
Kapiolani Community College	Hawaii
University of Nebraska	Lincoln, Neb.

October

Superintendent of Schools	Stockton, Calif.
Monroe Public Schools	Monroe, Mich.
Colorado State University	Fort Collins, Colo.
Bureau of Social Science Research, Inc.	Washington, D.C.
Penn Hills School District	Pittsburgh, Pa.
Rutgers State University	New Brunswick, N.J.
University of Nebraska	Lincoln, Neb.

A. Figueroa-Colon Consultant in Human Resource	Rio Piedras, Puerto Rico
L. F. Gordge, Chief - Industrial Trades, Dept. of Labour	Toronto, Canada
Garland S. Wollard Director of Education	Washington, D.C.
December	
Poudre High School	Fort Collins, Colo.
January, 1968	
Board of Education of Caroline County	Denton, Md.
February	
John Rosser	Willingboro, N.J.
George J. Ellis	Port Angeles, Washington
Lloyd J. Phipps	Urbana, Illinois
Judith B. Joern	Lincoln, Neb.
Wilbur S. Hoppengardner	Denton, Md.
Dr. Lawrence Zane Vocational Education	University of Hawaii
March	
Bruce McKinlay Manpower Research Project	Eugene, Oregon
Gladys Sachse Assistant Librarian	State College of Arkansas
Earl P. Murphy, Ph.D. Professor of Education	Western Kentucky University
Albert W. Hedemark	Belmont Senior High School Belmont, Mass.

Appendix G, continued

April	
David Hawkridge Project Director	American Institues for Research
William F. Ashmore Vocational Counselor	Colton High School, California
Patricia R. Allen Supervisor in Education	Commonwealth of Massachusetts Boston, Mass.
C. D. List	U.S. Department of Justice Terre Haute, Indiana
Joe M. Floyd Assistant Professor	Tennessee Technological Univ.
Grant W. Jensen Assistant Superintendent	Kern High School District Bakersfield, Calif.
May	
Ralph A. Rush Seminar Director	Rutgers University
June	
Richard G. Bentley, Professor Industrial Technology Division	Kent State University
Gertrude H. Franklin Teachers College Library	New York City, N.Y.
Marri DeCosin Readers' Adviser	Trenton State College
Richard Bickhaus Vocational Counselor	Ferguson-Florissant School District
Alex M. Robson Course Material Consultant	O'Fallon Technical High School St. Louis, Missouri

July	
J. J. Thompson, Director Referral Service Network	Kent State University
Richard L. Barker, Director N. H. Research Coordinating Unit	New Hampshire Department of Education
Joseph Eckl, Supervisor Bureau of Practical Arts	Chicago, Illinois
Dr. George H. Ditlow	Department of Public Instruction Millersville, Pa.
Mrs. Lela Willis	Metropolitan High School Little Rock, Ark.
August	
George B. Shapiro, Coordinator Adult Distributive Education	Board of Education Woodbridge, N.J.
September	
William Wolansky, Assoc. Professor Industrial Education Department	Oregon State University
Lauris Reichard Research Associate	Research & Information Services for Education, King of Prussia
Dr. Lawrence Latour Assistant Professor	State College At Westfield, Mass.
October	
Dr. Paul Hoffman, Director Vocational Rehabilitation Program	Stout State University, Wisc.
Dr. James Rokusek	Eastern Michigan University

Appendix G, continued

November

Ken Box, Director Vocational and Adult Education	Beaverton School District, Oregon
Richard A. McDonald Vocational Coordinator	Hanover Community Unit School District, Hanover, Ill.

December

H. James Rokusek, Professor Department of Industrial Education	Eastern Michigan University
Dale Jarvis Fiscal Officer	Human Resources Research Office Alexandria, Va.
David A. Campbell Program Specialist-Guidance	Sacramento City Unified School District
Roy L. Butler Acquisition Specialist	Ohio State University
R. E. Carey, Coordinator Vo-Ag	Bushnesll, Florida

January, 1969

D. E. Carpenter Library Assistant	Ontario Institute for Studies in Education, Toronto, Canada
Darius R. Young, Ph. D. Department of Industrial Education	Oregon State University
Robert D. Brown, Professor Industry and Technology	Northern Illinois University
Dr. Milton E. Larson, Professor Vocational Education	Colorado State University

February

Robert C. Young, Specialist Assistant Professor of Economics	Ohio State University
A. Harry Passow, Professor	Teachers College, Columbia University
June R. Chapin, Ed. D.	Menlo Park, California

Francis J. Pilecki	Merrimack Valley Regional Educational Planning Center
Henry S. Dyer Vice President	Educational Testing Service Princeton, New Jersey
Raymond C. Hummel Associate Professor	University of Pittsburgh
The RAND Corporation	Santa Monica, California
Vernon S. Gerlach, Chairman Educational Technology	Arizona State University
Richard Kraft Assistant Professor	Florida State University
C. W. McGuffey, Professor Educational Administration	University of Georgia

March

Marilyn Jones	Atlanta, Beorgia
Ernest Edwards, Director	West Virginia State College
Harry Wigderson, Director Research & Evaluation	ADAPT, Visalia, California
W. E. Ellis, Director Office of Research	Department of Education, S.C.
Robert A. Bigsby Department of Industrial Education	Oregon State University
Orville Nelson, Research Sepcialist American Industry Project	Stout State University
George Hagiwara, Teacher Trainer EWC Micronesian Occupational Teacher Training Program	University of Hawaii
Glen O. Fuglsby, Cahirman Industrial Education & Technology	Eastern Washington State College
Raymond C. Manion, Research & Evaluation Specialist	McReal - Mid-continent Regional Educational Laboratory, Kansas City, Missouri
Clyde F. Fake	Oakland Unified School District

Appendix G, continued

April

Ontario Institute for Studies in Education	Ontario, Canada
Rose Bower Ass't Librarian Department of Public Instruction	Shippensburg, Pa.
Timothy Keane	Peabody, Massachusetts
Thomas C. Oliver District Director American College Testing Program	Champaign, Illinois
Vernon L. Hendrix Assistant Dallas County Junior College District	Dallas, Texas
A. J. Gregan County Coordinator	Bisbee, Arizona
Marjorie W. Estes Curriculum Coordinator	Tucson, Arizona
Lois A. Gaillard, Director Curriculum Laboratory	Howard University Washington, D.C.
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TITLE
The Implementation and Further Development of Experimental Cluster Concept Programs Through Testing and Evaluation Including Placement and Follow-up of the Subjects. (Final Report, Phase IV)

PERSONAL AUTHOR(S)
Drs. Donald Maley and Walter S. Mietus

INSTITUTION (SOURCE)
University of Maryland, Dept. of Industrial Education, College Park

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RETRIEVAL TERMS
Cluster Concept Programs Vocational Education
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IDENTIFIERS Electro-Mechanical; Construction; Metal Forming & Fabrication Clusters

ABSTRACT

.Cluster Concept Programs (alternate forms of vocational education) were designed for the preparation of 11th and 12th grade students for entry level capability into a variety of related rather than specific occupations. Commonalities of jobs within occupations were derived from task analyses, which were further analyzed into human requirements. Three programs were developed: (1) The Electro-mechanical cluster included tasks for radio, TV appliance, typewriter, air cond. and refrig. servicing; (2) Construction cluster included tasks for carpentry, masonry, plumbing, electrical and painting; (3) Metal forming and fabrication included tasks for machining, welding, sheet metal and assembly jobs.

.Curriculum outlines, instructional plans, units of study were made and teachers were trained to implement the programs. To obtain an estimate of the effectiveness of the programs a pretest/posttest experimental and control group type design was employed. Newly developed achievement tests, rating scales, task inventories, check lists and also standardized tests were used to evaluate selected cognitive, affective and psychomotor behaviors.

.Ten schools were used. Varying degrees of attaining the specified objectives were observed. In some schools statistical, significant differences and gains were made, in others, only moderate changes were observed. Each field operation was evaluated in terms of tasks performed by the teacher and student, administrative support, equipment, materials, physical facilities and finally, job placement. Data from unique placement efforts indicated that 4 weeks after graduation 86% of the graduates were gainfully employed, up to 60% were in cluster related occupations.